CASE STUDIES

Each dam is unique, and its ecological, social, physical, and economic context must be carefully considered when exploring future scenarios. Unlike large dams—where few options beyond removal can achieve multiple project objectives—small dams often present a wider range of feasible alternatives. While dam removal may be the most effective means of restoring river functions and ecological connectivity, the social, physical, and economic dimensions of a community may justify exploring additional options.

While typical design charrettes are open-ended and generative, dam-related planning processes benefit from a structured exploration of known alternatives—such as dam removal, partial removal, nature-like fishways, or rehabilitation—while still leaving space for creative, site-specific solutions that may emerge from the community.

Case studies are an effective way for both the steering committee and the general public to learn how other communities have addressed aging dam infrastructure. They familiarize participants with common alternatives and provide a shared foundation for discussion about possible solutions for the project at hand. Seeing examples of completed projects—such as photographs of restored river reaches—can help participants visualize future conditions and reduce uncertainty or fear of change. Case studies also help illustrate the types of technical, financial, and regulatory support needed to advance projects and highlight potential funding opportunities and constraints relevant to local decision-making.

PRE-WORKSHOP PREPARATION

Meeting organizers should select case studies that match the scale, type, and context of the dam being discussed. This resource includes downloadable PDFs of sample case studies, as well as editable Microsoft Word and Google Doc templates for creating new ones.

- Print the case studies double sided on 8.5x11 sheets of paper.
- Print enough copies so that each table has at least one of each case study.
- If you plan to run multiple workshops, consider printing on card stock for durability and reuse.

THE EXERCISE

During the presentation, the facilitator should introduce the case studies, highlighting key project details and outcomes. Using before-and-after photographs is especially effective for helping participants visualize the impact of different alternatives.

After the presentation, distribute the printed case studies to each table and ask participants to review them together.

Once everyone has had time to read and discuss, invite the group to reflect on the following questions:

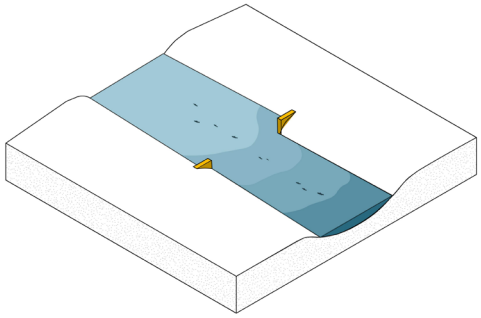
- Are there any questions about the case studies?
- What aspects of each case study seem most relevant to the decision at hand?
- Given what we learned from these examples, what alternatives might be appropriate to consider for this project?

DAM REMOVAL

Dam removal provides full habitat connectivity and fish passage up and downstream. It eliminates the risk of dam failure and avoids long-term maintenance and repair costs. It represents a "one and done" solution to the many aging dams in the region. Removal also allows canoes and kayaks unobstructed passage downstream without the need for long and sometimes dangerous portages (carrying a boat around the dam).

Dam removal requires careful study and engineering to assure that neighboring infrastructure, such as bridges and roadways are not damaged by changes in the river channel. Studies are also needed to understand the impact of lowering the upstream water elevations on wells, upstream wetlands, recreation and private properties along the impoundment. While dam removal can be expensive up-front, there is no long-term cost or maintenance required once the dam is removed.

DAM REMOVAL



FISH PASSAGE UP AND DOWN STREAM

Low Fish Passage — 1 2 3 4 5 — *High Fish Passage*

UPSTREAM WATER LEVELS

Potential Lowering of Water Levels — 1 2 3 4 5 — *Maintain Existing Upstream Water Levels*

RECREATION ON THE IMPOUNDMENT

Reduced Flat Water Recreational Opportunities — 1 2 3 4 5 — *Maintains Existing Flat Water Recreational Opportunities*

RECREATION ON THE RIVER

Maintains Existing Difficulties to River Recreation — 1 2 3 4 5 — *Improves River Recreation by removing hazards and portages*

VISIBILITY OF DAM

Dam Structure No Longer Visible — 1 2 3 4 5 — *Dam Structure Remains Visible*

WATER QUALITY

Maintain Existing Water Quality — 1 2 3 4 5 — *Improve Water Quality*

RISK OF DAM FAILURE

No Risk of Failure — 1 2 3 4 5 — *Maintain Existing Risk of Failure*

UP-FRONT COST

Less Expensive — 1 2 3 4 5 — *More Expensive*

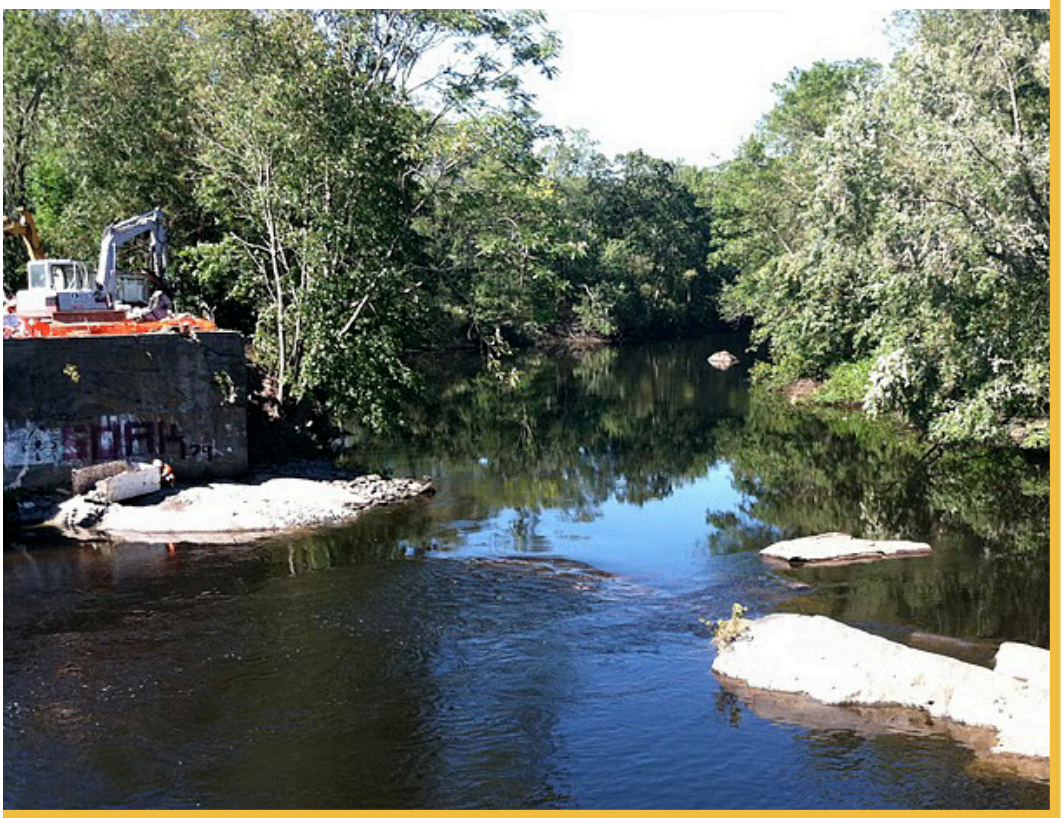
LONG-TERM COST AND MAINTENANCE

Lower Long Term Cost And Maintenance — 1 2 3 4 5 — *Higher Long Term Cost And Maintenance*

PAWTUXET FALLS DAM

PROJECT SUMMARY

In the 19th century, dams constructed along the Pawtuxet River helped to power Rhode Island's textile industry. Years of industrial use, including the release of untreated chemicals from the Ciba-Geigy chemical plant, left the river heavily polluted. Poor water quality led to declines in fish population and river access for the local community. After decades of investments aimed at improving water quality and habitat in the river, the decision was made to remove the Pawtuxet Falls Dam. For hundreds of years, the Pawtuxet Falls Dam blocked migratory fish passage as the first of many dams leading from the Narragansett Bay through the mill towns situated along the river.



LOCATION
Cranston and Warwick, RI

RIVER
Pawtuxet River

YEAR
2011

GOAL
Migratory fish passage

TYPE
Partial removal

COST
Approximately $1,000,000 including permits, engineering, and project management; construction cost of approx. $800,000

PROJECT PARTNERS
Pawtuxet River Authority & Watershed Council (PRA); Narragansett Bay Estuary Program; USDA Natural Resources Conservation Service; RIDEM; RICRMC; The Rhode Island Foundation; USEPA; National Oceanic and Atmospheric Administration; US Fish and Wildlife Service; American Rivers; Save The Bay; RI Saltwater Anglers Association; Friends of the Pawtuxet; Pawtuxet Village Association; City of Cranston; City of Warwick; Restore America's Estuaries; RI Rivers Council; RI Corporate Wetlands Partnership; Rhodes-on-the-Pawtuxet; Hunter's Garage 66.

CHALLENGES:

There were multiple hurdles that needed to be overcome before the dam could be removed. Design issues were complicated as stakeholders wished to minimize changes to the river's morphology. However, bedrock in the area was not stable enough to safely navigate river herring upstream and allow for a full dam removal. The water quality and sediment were degraded by more than a century's worth of upstream discharge of human and industrial waste, including the hazardous waste. Furthermore, at the time, it would have been the largest ecological dam removal undertaken in Rhode Island. Lastly, Pawtuxet Falls Dam was in a highly visible historic location and the dam and waterfall were part of the local landscape and sense of place.

SOLUTIONS:

In 2011, a project led by the Pawtuxet River Authority and Narragansett Bay Estuary Program, along with dozens of partners, used excavators to strategically demolish the concrete spillway. Native wetland plantings were installed along the newly exposed river banks to aid habitat restoration goals. Today, anadromous fish populations like river herring and American shad are once again able to travel upstream to spawn.

This project employed a process of ongoing public interaction, including advocacy on the part of a local business owner. Eight public meetings were held over four years, during which time, assessments and design plans were completed. During this process, the design was modified due to the bedrock conditions. The final design resulted in a portion of the dam staying in place to divert flow and fish in a way that promotes successful upstream migration.

SUCCESSES:

A NOAA representative reflecting on the process asserted that the biggest hurdle was consensus-building. Ultimately, community consensus was reached, and for the first time in three hundred years, this section of the river was able to flow freely into Narragansett Bay, restoring 7.5 miles of spawning habitat above the dam.

LESSONS LEARNED:

For highly visible dams, the public process is very important to build an understanding of the project trade offs and the varying community interests.

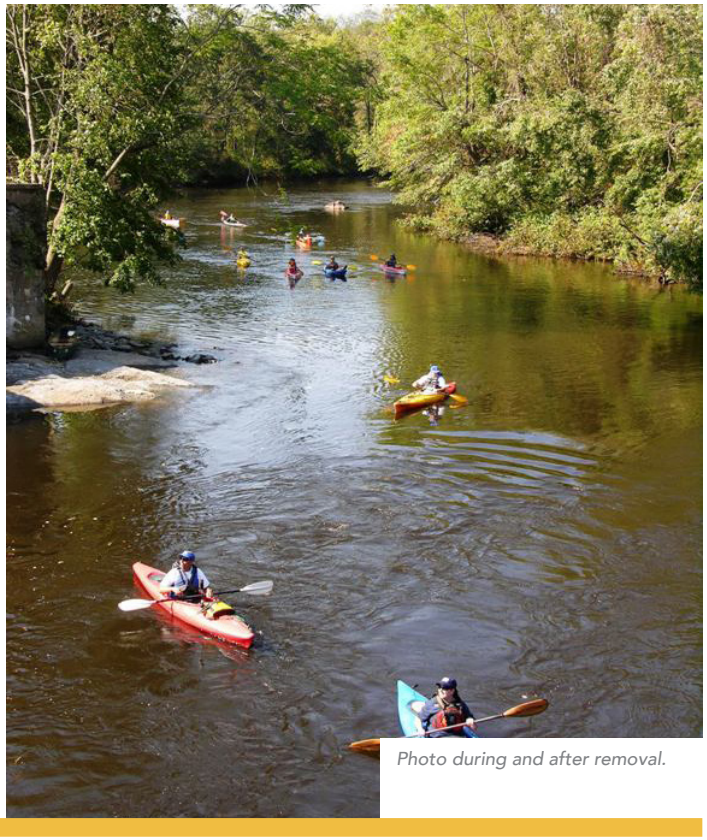


Photo during and after removal.

REFERENCES and ADDITIONAL RESOURCES

NBEP presentation: https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1212&context=fishpassage_conference

Cranston Herald Article: https://cranstononline.com/stories/village-celebrates-dam-removal-opening-pawtuxet-to-migratory-fish,63352

CASE STUDIES - REMOVAL

LOWER SHANNOCK FALLS

PROJECT SUMMARY

Lower Shannock Falls Dam, located on the Upper Pawcatuck River between Charlestown and Richmond, was erected in the early 1800's. This site contains historic significance to both the Narragansett Tribe and Anglo-European communities. The Lower Shannock Falls dam removal was part of a comprehensive project that opened fish passage through seven dams along the Pawcatuck River. The dam was removed in 2010 but modifications were made in 2011 to improve flow conditions.

LOCATION
Charlestown/Richmond, RI

RIVER
Pawcatuck River

YEAR
2010

GOAL
Migratory fish passage

TYPE
Complete removal with Historic Signage and Artifacts

COST
$843,470 including: Feasabilty Assesment (~$42,300), Design and Permitting ($187,260), Construction and Oversight ($588,910), Post- Construction Monitoing (~$25,000).

PROJECT PARTNERS
Wood Pawcatuck Watershed Association; Trout Unlimited; United States Fish and Wildlife Service; RI Coastal Resources Management Council; RI Department of Environmental Management; National Oceanic and Atmospheric Administration; Save the Bay; Richmond Conservation Commission; Town of Richmond; USDA Natural Resources Conservation Service; American Rivers; and Narragansett Bay Estuary Program.

CHALLENGES:

Initially, the neighboring community was not in favor of the design and construction that was needed for the dam to be removed. Some residents were worried that the diversion of the river during the construction process may have negative ecological impacts. Others were concerned that the site would not reflect its historical significance to both Anglo-Americans and the Narragansett Tribe . Additionally, others were worried that when the dam was removed, the water would be too turbulent to permit recreational use.

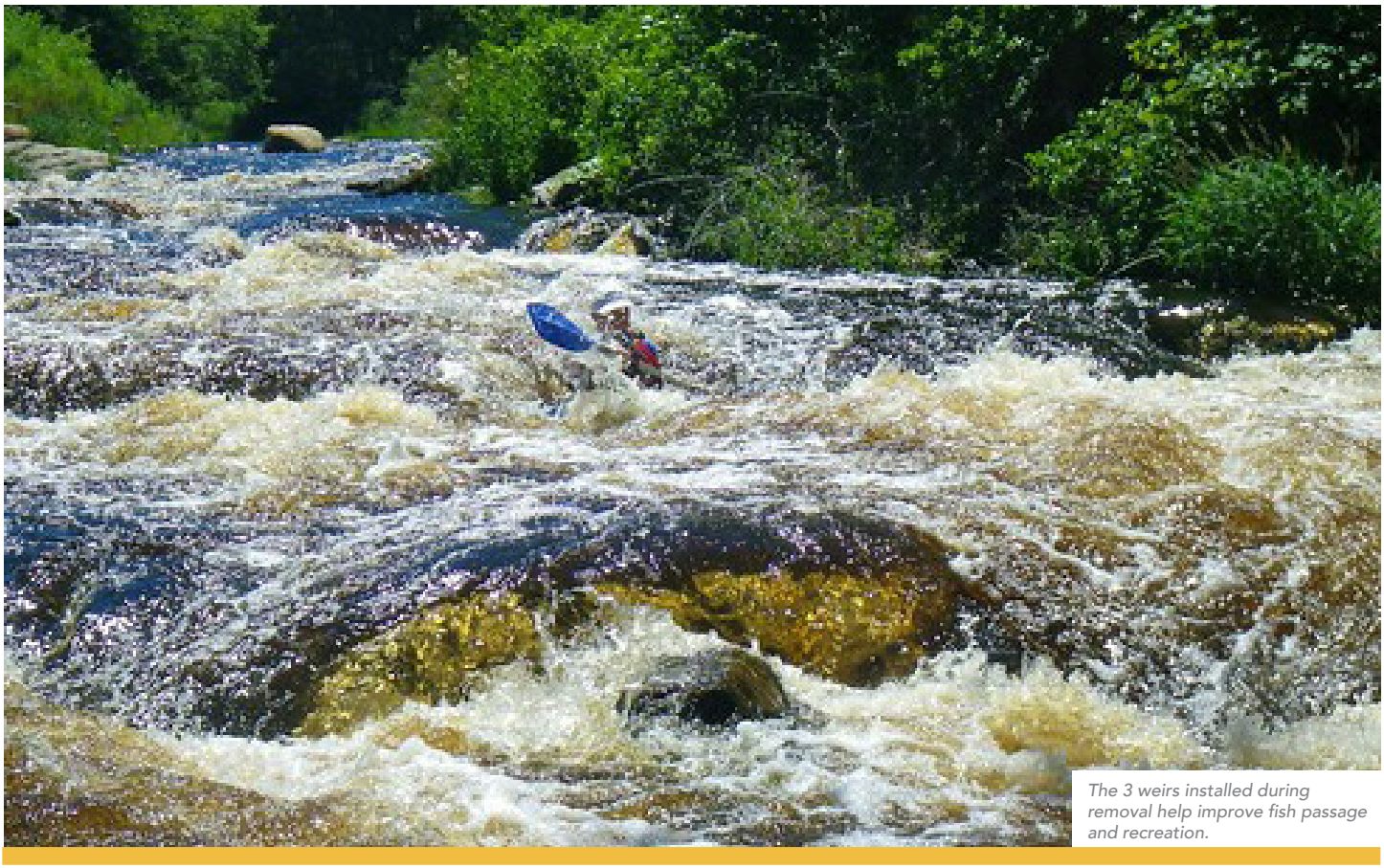
SOLUTIONS:

In 2010, the dam was removed and three weirs were installed to ensure that river flows met the migratory needs of the fish. The Knowles Mill Public Park was developed by the town of Richmond on the river bank below the falls providing trails as well as fishing and boating access downstream of the former dam. The historic smoke stack from the mill was left in place and interpretive signs were installed in the park to document the historic and cultural importance of the area.

SUCCESSES + LESSONS LEARNED:

Throughout the project, the project team consulted with the local community and the Narragansett Tribe. This collaboration allowed for the historical preservation concerns of the community to be addressed while allowing for the dam to be removed. By creating a public park surrounding the old dam site, public access to the river was enhanced. The history of the site is communicated through the preservation of ruins as well as signage in the park that displays historic photos.

The project benefited from a team experienced in fishery biology, hydrology/hydraulics, sediment transport, and water management. Completing the weirs in "dry" conditions helped achieve elevations and other design features required for fish passage. Testing river flows during and following construction allowed site-specific modifications that would help fish in their migration up and down the river.



The 3 weirs installed during removal help improve fish passage and recreation.

REFERENCES and ADDITIONAL RESOURCES

NOAA's presentation: "Advancing Anadromous Fish Passage Efficiency Lower Shannock Falls Dam Removal Pawcatuck River, Rhode Island" https://www.estuaries.org/pdf/2010conference/tuesday16/galleon3/session3/turek.pdf

CASE STUDIES - REMOVAL

WHITE ROCK DAM

PROJECT SUMMARY

For over 200 years, there have been dams at the mouth of the Pawcatuck watershed. In 1938, these historic dams were replaced by the White Rock Dam. It spanned 108 feet across the Pawcatuck River and stood six feet high. The dam blocked most fish passage from the Atlantic Ocean into the Pawcatuck River. Although a raceway was available to migrating fish, it only passed fish under perfect stream conditions; studies showed that only 15 percent of fish were able to battle through the strong currents in the narrow channel. Flooding was another significant concern. Major flooding in 2010 damaged the structure, causing it to become a safety hazard.

LOCATION
Westerly, Rhode Island and Stonington, Connecticut

RIVER
Pawcatuck River

GOAL
Migratory fish passage; Flood abatement; Recreation enhancement

TYPE
Complete Removal

COST
$794,000

PROJECT PARTNERS
The Nature Conservancy; United States Fish and Wildlife Service; RI Coastal Resources Management Council; RI Department of Environmental Management; National Oceanic and Atmospheric Administration; the Wood-Pawcatuck Watershed Association; and Save the Bay.

CHALLENGES:

White Rock Dam was privately owned and adjacent to three other properties. It spanned across the Connecticut and Rhode Island border. One of the greatest challenges was that the dam was under the jurisdiction of two states.

SOLUTIONS:

The removal of the White Rock Dam required stakeholder and decision-maker integration across both states. The owner of the dam, who would be liable for damages if the dam were to fail, allowed the removal of the dam. There was no significant push back from the owners of the other adjacent properties. Working across state boundaries provided significant permitting challenges, but coordination between government agencies and environmental organizations in both states allowed the process to move forward. Two separate filings -- an 800-page application in Connecticut and a 650-page application in Rhode Island -- resulted in approval of the dam removal permits.

SUCCESSES:

Removal of the dam eliminated a hazardous structure, which minimized possible flooding downstream while allowing diadromous fish species to regain passage to and from the ocean. The White Rock Dam was the first dam blocking migratory flow from the Narragansett Bay through the Pawcatuck River. The removal of the dam spurred subsequent projects upstream.

LESSONS LEARNED:

Cooperation with other agencies is necessary especially when working across state boundaries: Sally Harold, from the Connecticut chapter of The Nature Conservancy, stated, "A lot of it means we have twice as much work to do. We have two agencies to work with, but it also means we can double-dip fisheries biologists from both sides, from both agencies, and there's been great cooperation between agencies and other project partners from both sides of the river."

The White Rock Dam was under the jurisdiction of two states which added to the complications of the project.

REFERENCES and ADDITIONAL RESOURCES

FUSS and O'NEILL: https://www.fando.com/project/white-rock-dam-removal/

https://www.ctpublic.org/environment/2015-09-08/dem-begins-white-rock-dam-removal-along-pawcatuck-river

CASE STUDIES - REMOVAL

MILL RIVER DAMS

PROJECT SUMMARY

Mill River, a 4-mile long tributary of the Taunton River, historically provided habitat and spawning grounds for migratory and resident fish, such as river herring, yellow perch, chain pickerel, American eel, and trout. The river was an active fishing location for native peoples for centuries until their forced removal from the area. At that point, colonists constructed a series of dams, which provided water and power to settlers, but cut off major fish runs. As a result of these obstructions and pollution from upstream manufacturing, a Massachusetts state report declared the river "dead" in terms of alewife population in 1921. In 2005, the decaying Mill River Dams were thrust into the national spotlight when Whittenton Dam nearly failed, forcing thousands of local residents to evacuate their homes and costing the city close to $1.5 million. Failure of the dam was narrowly avoided in this case, but community and regulatory attention turned toward finding solutions as dam failure may have led to major loss of life and property in downtown Taunton.

LOCATION
Mill River, Massachusetts

RIVER
Mill River

YEAR
Hopewell Mills 2012;
Whittenton 2013;
West Britannia 2018

GOAL
Reduce flooding risk, Migratory fish passage, Recreation and habitat enhancement

TYPE
Complete Removal of two dams; Reconstruction of one dam

COST
$1,574,000 (estimated total)
West Brittania Dam removal: $354,420
Whittenton Dam removal: $650,435
Morey's Bridge Dam (dam reconstruction, fish ladder/ eel ramp installation): $4.3 million (includes cost of bridge replacement)

PROJECT PARTNERS
The Nature Conservancy, NOAA, American Rivers, the Coastal America Foundation, the National Oceanic and Atmospheric Administration, the Massachusetts Division of Ecological Restoration, U.S. Fish & Wildlife Service, the Massachusetts Division of Marine Fisheries, Southeastern Regional Planning and Economic Development District, Save the Bay, USDA-Natural Resources Conservation Service, MA Department of Mental Health, MA Department of Transportation, Mass Audubon, Taunton River Watershed Alliance, Corporate Wetlands Restoration Program, Acuity Management and other dam owners.\

CHALLENGES:

Because multiple dams (West Brittania, Whittenton, and Morey's Bridge) were involved in this project, each had its own set of challenges.

SOLUTIONS:

In response to the near dam failure, risk posed to the surrounding communities, and an effort to reconnect the area to the Wild and Scenic Taunton River, three dams were removed over a series of years(Hopewell Mills in 2012, Whittenton in 2013, West Britannia in 2018). Morey's Bridge Dam was left in place, but a fish ladder and eel ramp was installed in 2012 as part of a bridge restoration project through the Department of Transportation.

SUCCESSES:

With a release of natural sediment held back by the dams, the river has begun to restore its natural channel, with increased biodiversity, and recreational access from the Narragansett Bay to the headwaters of the Mill River. The dam removals and reconstruction restored fish passage to 30 miles of habitat in the Taunton Watershed. River herring and sea lamprey have been reported in the area for the first time in 200 years. The project has also improved recreational access and reduced flooding threat to local communities--and has spurred secondary projects like the Weir Village Riverfront Park, which provides a waterfront walkway, boat ramp, and fishing pier.

LESSONS LEARNED:

The near-failure of the Whittendon Dam highlighted the dangers of neglected historic dams. Repairing the Whittenton Dam alone would have cost an estimated $1.9 million. The cost of removing the dams, restoring the river, and reducing dangerous hazards was far less costly and provided more beneficial outcomes for local residents and habitats along this stretch of the Mill River.

The Mill River Dams are a good example of the benefit of taking a "river approach" to addressing dams to improve habitat connectivity. Rather than only repairing or removing the failing Whittenton Dam, the team used the crisis as a catalyst to address multiple decaying dams along the Mill River and as a result were able to improve habitat connectivity along 30 miles of the river.

Vegetation growing in along the restored river edge and paddling the river without obstructions.

REFERENCES and ADDITIONAL RESOURCES

Nature Conservancy: https://www.nature.org/en-us/about-us/where-we-work/united-states/massachusetts/stories-in-massachusetts/mill-river-restoration/

MASS DER: https://www.mass.gov/service-details/mill-river-restoration#:~:text=The%20Hopewell%20Mills%20Dam,constructed%20at%20Morey's%20Bridge%20Dam.

PUBLIC ACCESS

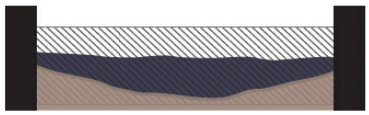
When dams are being considered for removal that are owned by state or local governments, there may be the possibility that removal can provide new public spaces adjacent to the river. These public spaces can provide public access to the river such as new walking trails, boat ramps, or fishing docks and help create or maintain a sense of place even if the landscape is changing. Landscape architects on the project team can work with the community to envision and design the future of public access to the surrounding landscape.

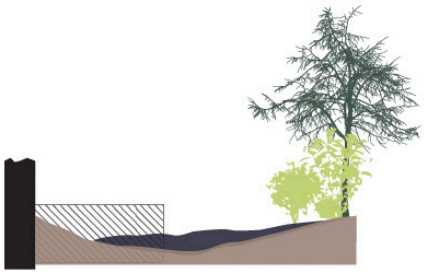
On some sites that are being considered for removal, the dam may be perceived as an important part of the local landscape and cultural history. There are design strategies that can help maintain a sense of place and/or preserve portions of the historic structures while restoring a free-flowing river.

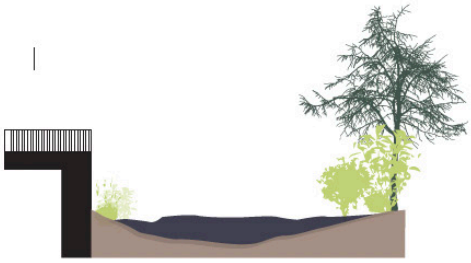
Some examples include:

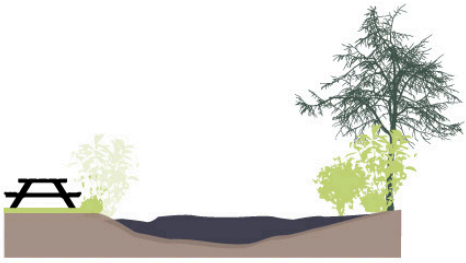
- A portion of the dam structure can be preserved on either side of the river channel to mark the historic location of the dam.
- The location of the dam can be marked with a piece of public art that can tell the history of the dam and site.
- The river can be diverted around the dam, but the structure can be preserved.
- Water features can be added that maintain the acoustic and aesthetics of the waterfall
- The area that was the impoundment can be maintained as a wet meadow to ensure views across the historic impoundment are maintained
- A trail at the historic elevation of the impoundment can be installed to mark its historic location
- Other features can be added that maintain the aesthetics of the dam and public access can be provided in the area surrounding the dam.

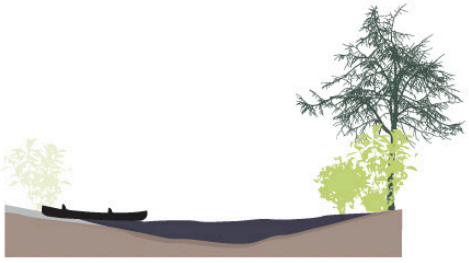
On the following pages, speculative ideas for how to design a site post removal are shared through a series of diagrams. In addition, there are a series of case studies where public access was a key aspect of the design.

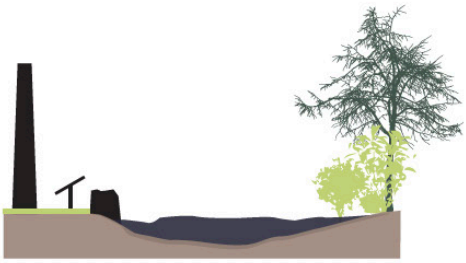


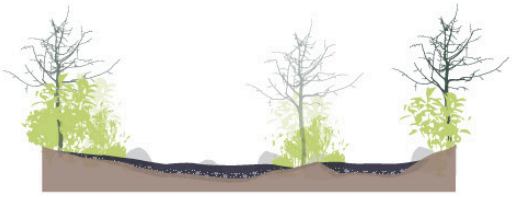


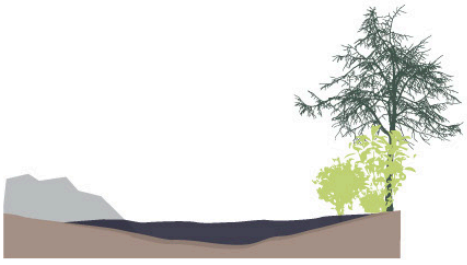


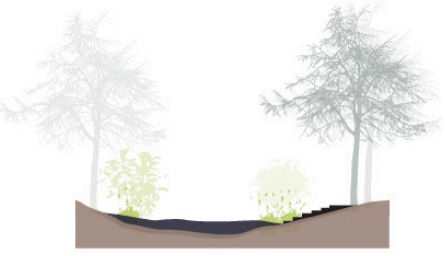


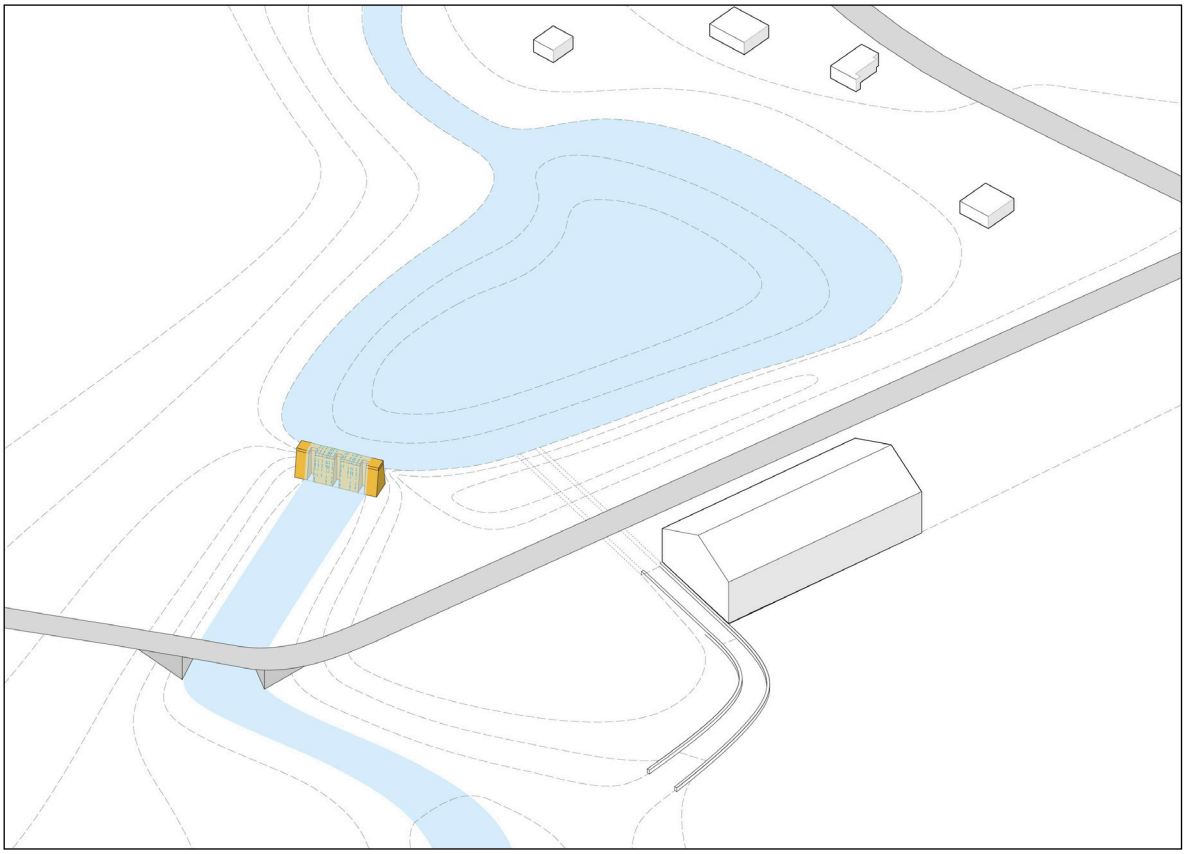




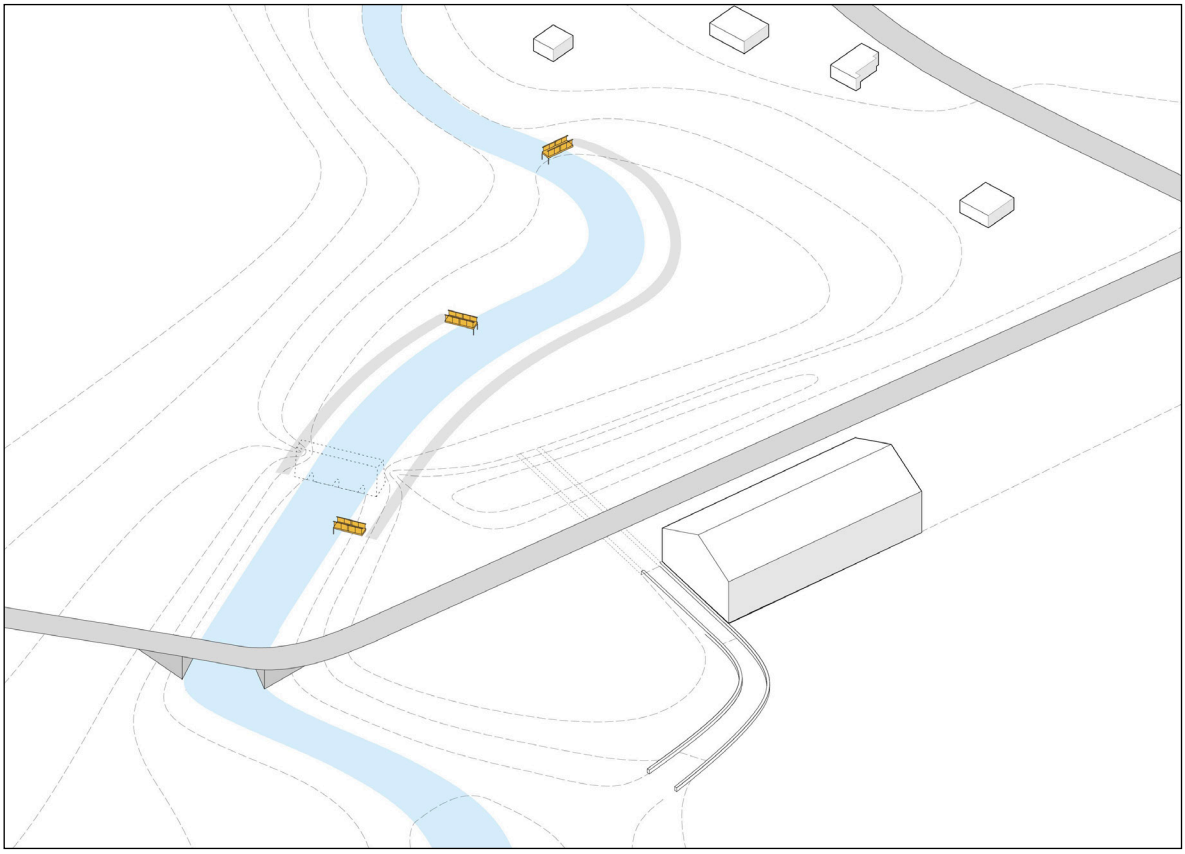




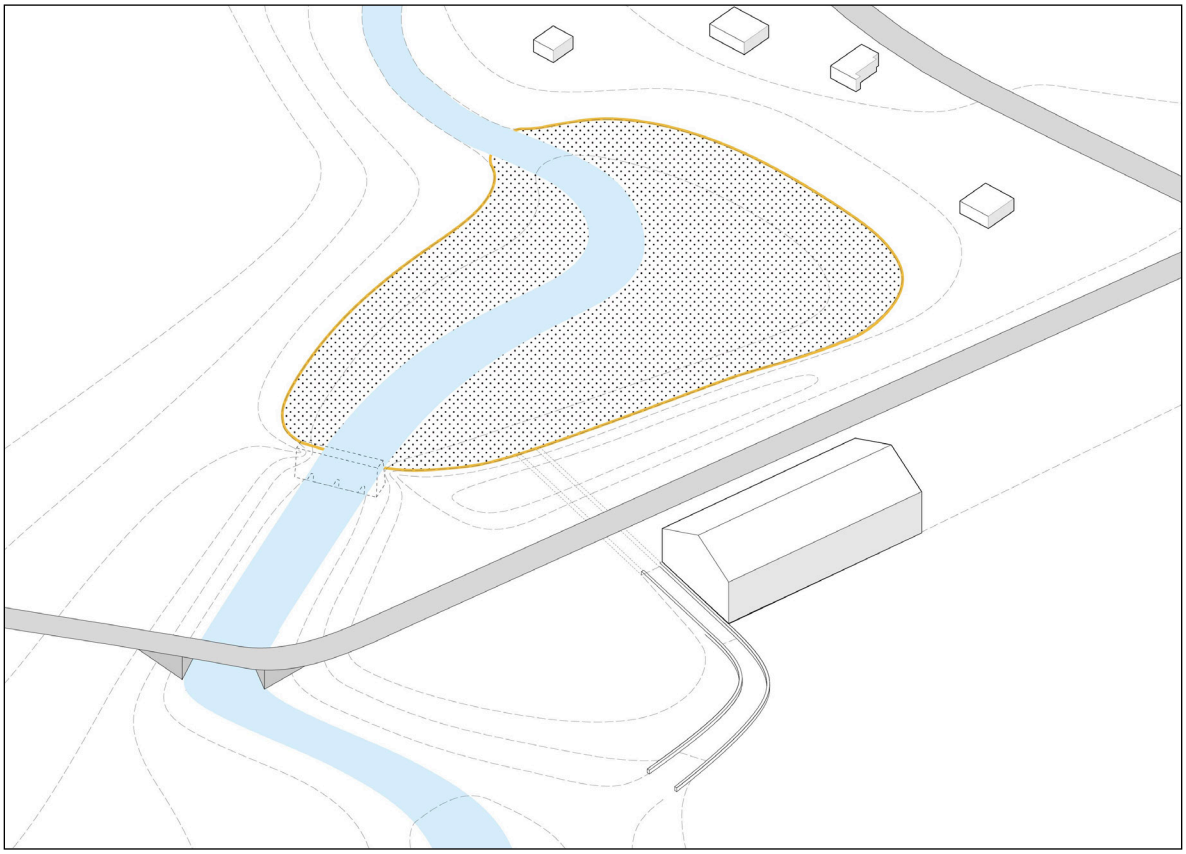




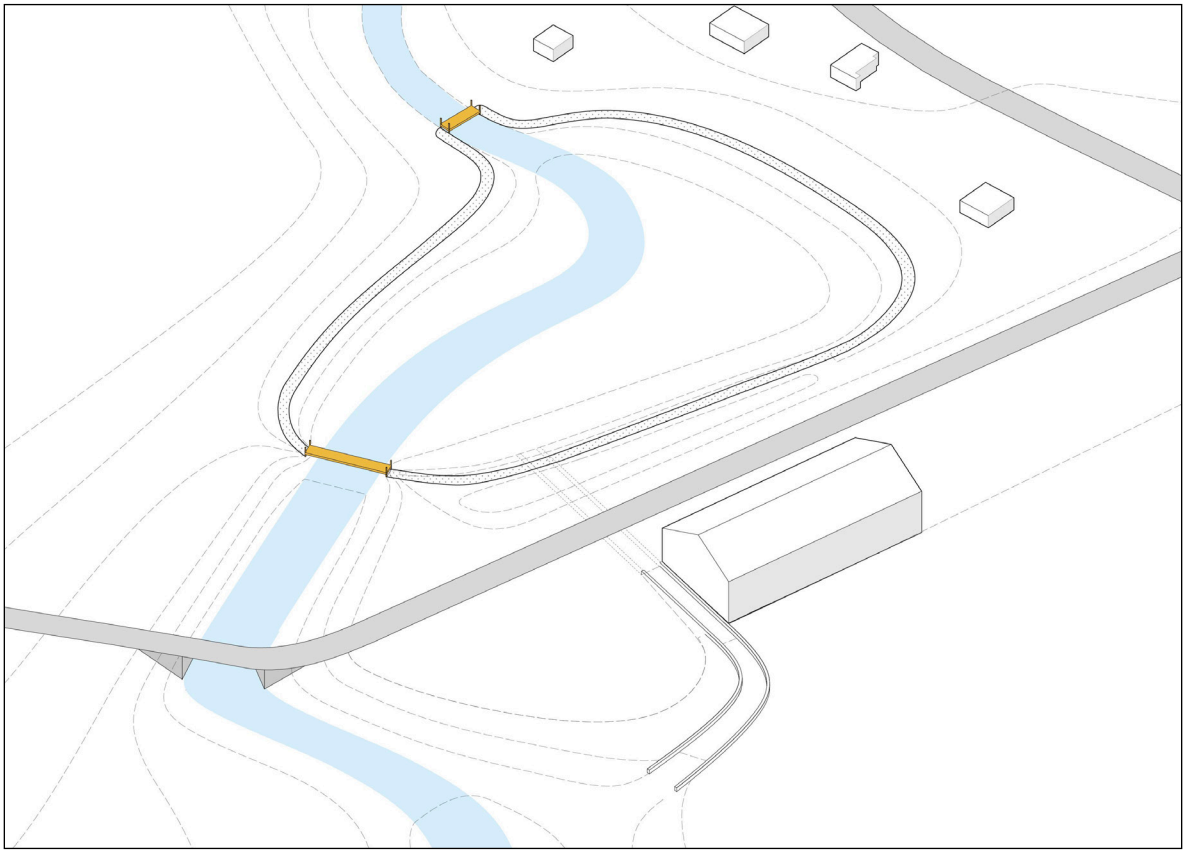
EXISTING CONDITIONS: Diagram of Existing Conditions- Dam and impoundment.



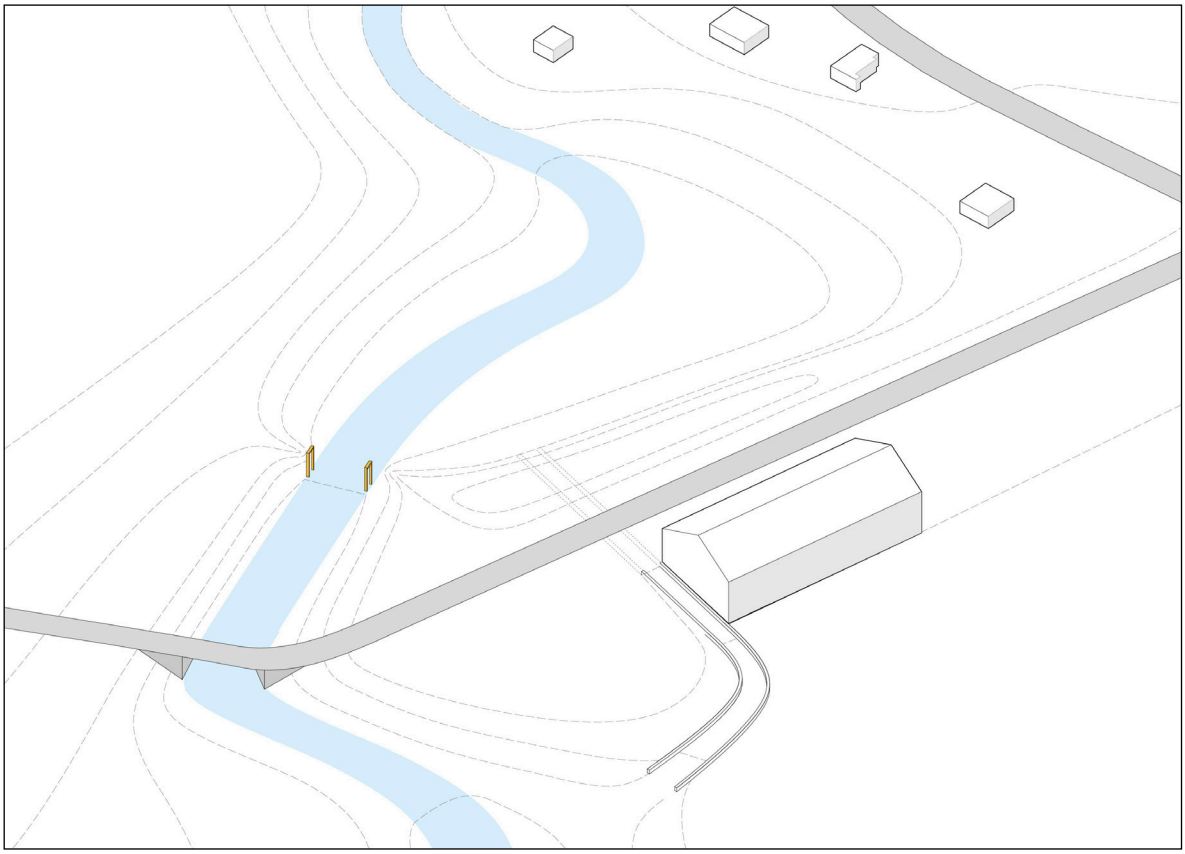
FISHING ACCESS: Fishing docks or rocks can be installed along river to improve fishing access and improve recreation.



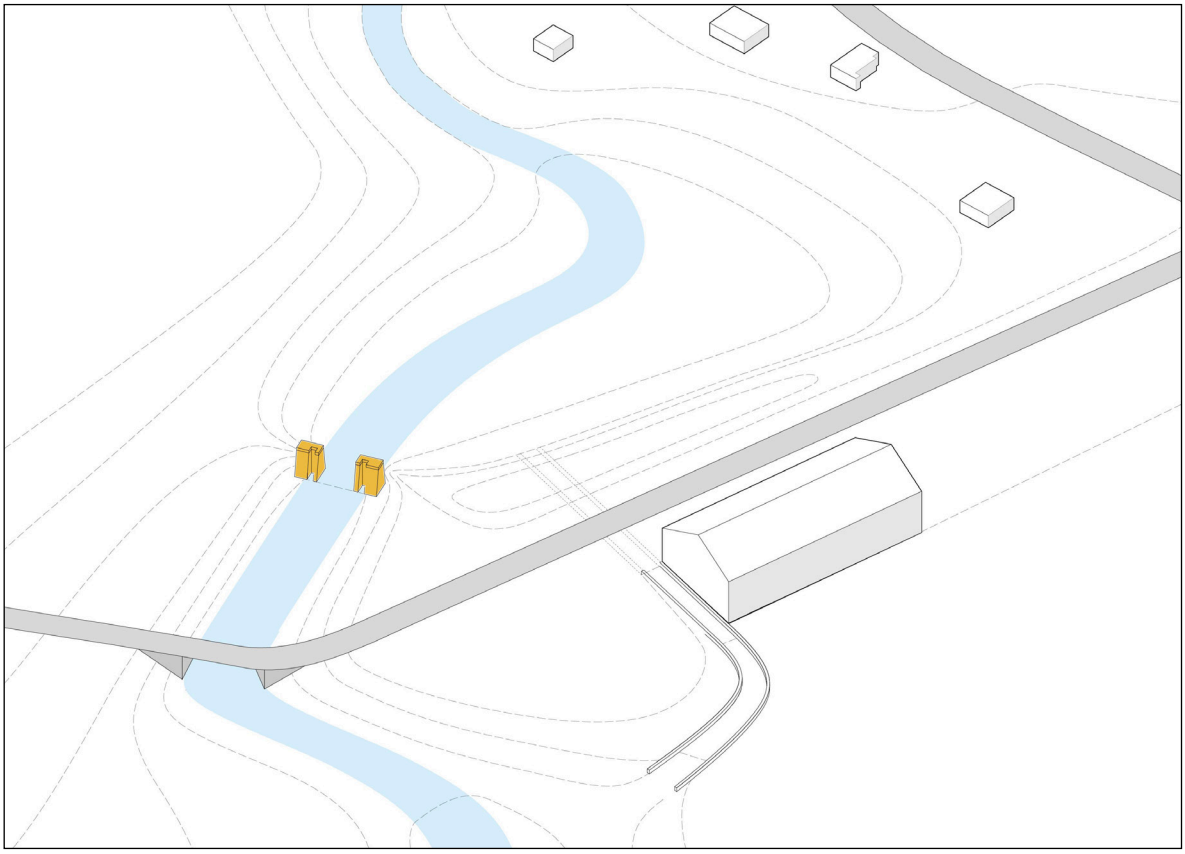
PUBLIC OPEN SPACE: The area that was the impoundment can be a new public space and maintained as a wet meadow to ensure views across the historic impoundment are maintained.



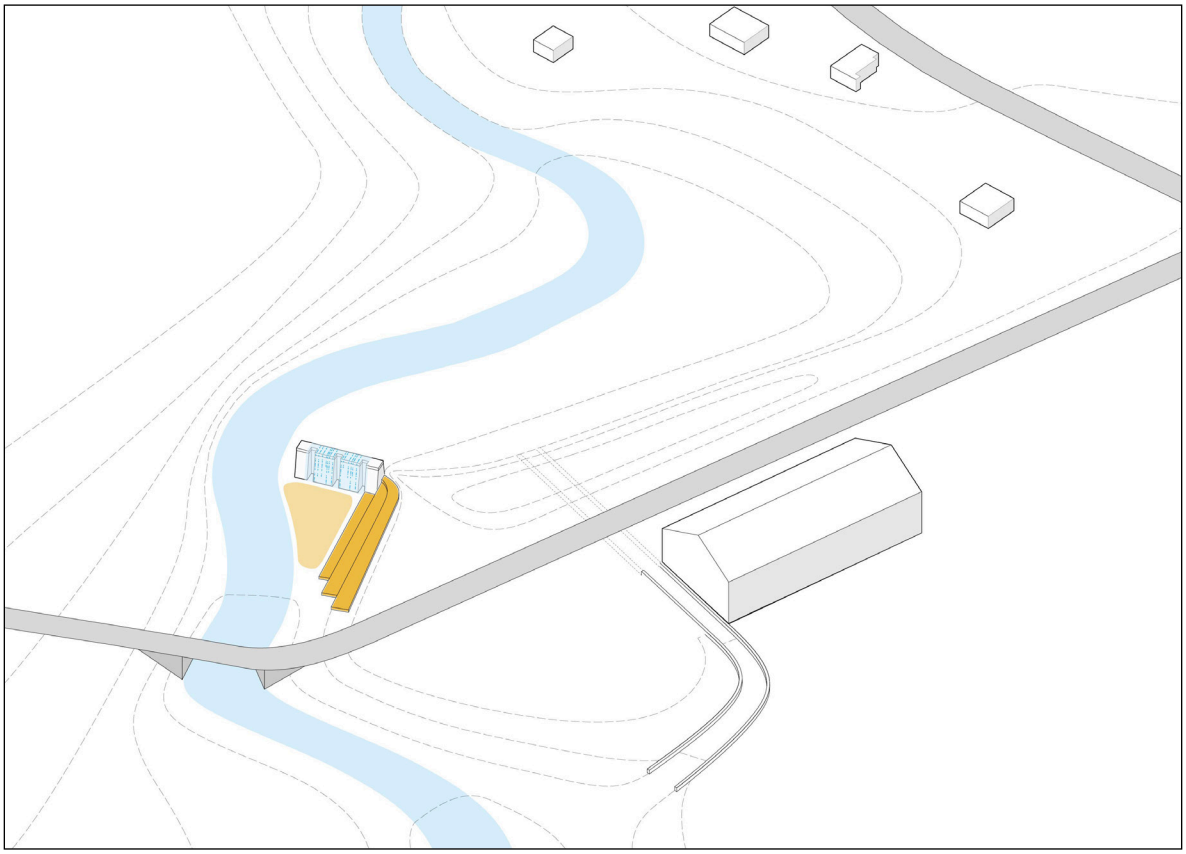
PATHS: Path can mark the location of the historic impoundment or provide trails to acccess the floodplain.



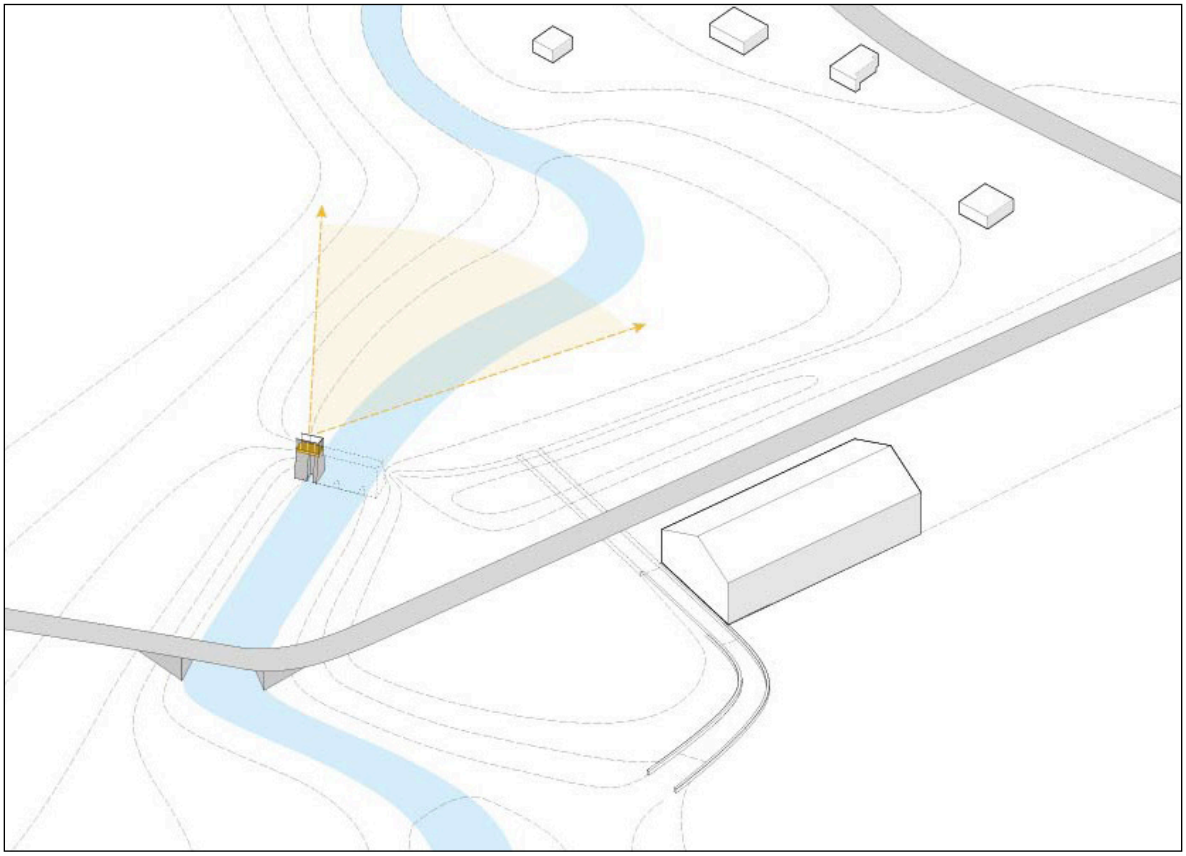
PUBLIC ART: Public Art sculptures can be installed to mark the historic location of the dam.



HISTORIC STRUCTURE: A portion of the dam can remain to mark the historic location and honor the history of the dam.



PUBLIC GATHERING SPACE: River can be diverted around the historic dam. A public gathering space can be constructed adjacent to the historic structure and a water feature installed to maintain the aesthetics of the waterfall.



OVERLOOK: An overlook can be constructed on top of the historic dam structure to provide views of the river.

KENT DAM AND WATERFALL

PROJECT SUMMARY

Although outside of the Narragansett Bay watershed, the Kent Dam case study is a useful example of a project that provided habitat connectivity, improved water quality, and historic preservation of a dam structure. The Cuyahoga River in Kent, Ohio has been a vital resource for people of the river valley since approximately 9,000 BC--acting as a travel corridor, water supply, and hunting and fishing grounds. The arch-shaped Kent Dam was constructed in 1836 to power various mills in the rapidly-industrializing Kent area. Because it is the oldest masonry dam in Ohio and the second oldest arch-shaped dam attached to a canal lock in the US, it has become an iconic feature of the city. However, after falling into disuse in the early 20th century, it caused dam pool stagnation, obstructed fish passage, and led to other water quality issues. The nation's attention was drawn to the Cuyahoga River in 1970, when industrial and sewage waste caused the river to catch fire. This event, along with others across the country, spurred the adoption of the Clean Water Act, which was passed in 1972 in an effort to "restore the chemical, physical and biological integrity of the nation's waters."

LOCATION
Kent, Ohio

RIVER
Cuyahoga River

YEAR
2005

GOAL
Improved water quality, Historic preservation, Migratory fish passage, Aquatic habitat

TYPE
Partial removal with historic preservation

COST
$5,013,150

PROJECT PARTNERS
The Ohio EPA; Kent Dam Advisory Committee; The City of Kent.

FUNDING SOURCES
The City of Kent
Ohio EPA WRRSP Grants
Clean Ohio Fund Grant
Ohio Department of Natural Resources Grant
Ohio EPA Section 319 Grant

CHALLENGES:

The stretch of the Cuyahoga River that ran through the defunct Kent Dam was cited for noncompliance with the Clean Water Act by the Ohio EPA for exceeding pollutant concentrations. The EPA informed the City of Kent that they must pursue a modification-removal of the dam or face more stringent permitting limits at the City's Water Reclamation Facility. Because this permitting would be costly to Kent taxpayers and have little benefit to the quality of the river, the City of Kent began the processes of review and public engagement necessary to remove the dam with historic preservation.

SOLUTIONS:

Due to the potential conflict between historical preservationists and environmental advocates, the city created a 19-member Kent Dam Advisory Committee (KDAC). Their goal was to examine feasibility and decision-making pathways by studying factors like applicable laws and regulations, water quality issues, historical significance, and fish migration routes. After several meetings, the KDAC proposed a solution: the removal of a concrete wall that had been placed across the old lock area. This removal would allow water to flow around the arch dam, which would improve water quality and allow fish passage while maintaining the historic arch structure. Tannery Park was constructed surrounding the historic arch dam and a pump circulates water so water continues to flow over the front of the dam.

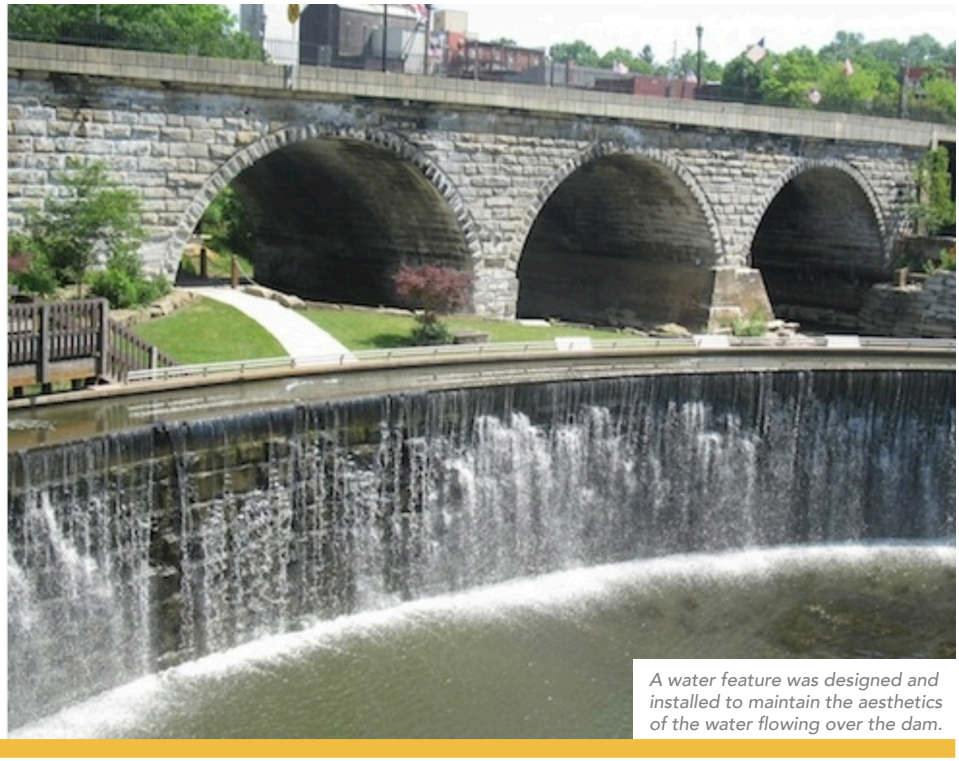
SUCCESSES:

By removing part of the dam to create a by-pass channel around the arch dam structure, the health of the river was restored without jeopardizing the historical aspect of the dam or interfering with the city's identity. Since the partial removal of the dam, once-stagnant pools that emitted a foul odor are now flowing and allows for migratory fish passage. Dissolved oxygen levels at Kent Dam have improved. Also, the adjacent Tannery Park was expanded to allow increased public access to the historic landmark.

LESSONS LEARNED:

By creating an advisory committee dedicated to research and resolution, the project team was able to reach a solution that met the needs of the environment as well as the citizens of Kent. Because so much national attention was focused on the project, early involvement spurred the Clean Water Act, strategies of engagement, analysis, and implementation; it even helped to inform similar projects across the country.

The Kent Dam is also a good example of a project that was able to achieve the dual goals of habitat connectivity and historic preservation. By creating a public park at the dam site, the history of the site and sense of place was able to be preserved and possibly enhanced. In addition, by adding a water feature to the arch dam artifact, the aesthetic and acoustic experience of being near a waterfall was preserved.



A water feature was designed and installed to maintain the aesthetics of the water flowing over the dam.

REFERENCES and ADDITIONAL RESOURCES

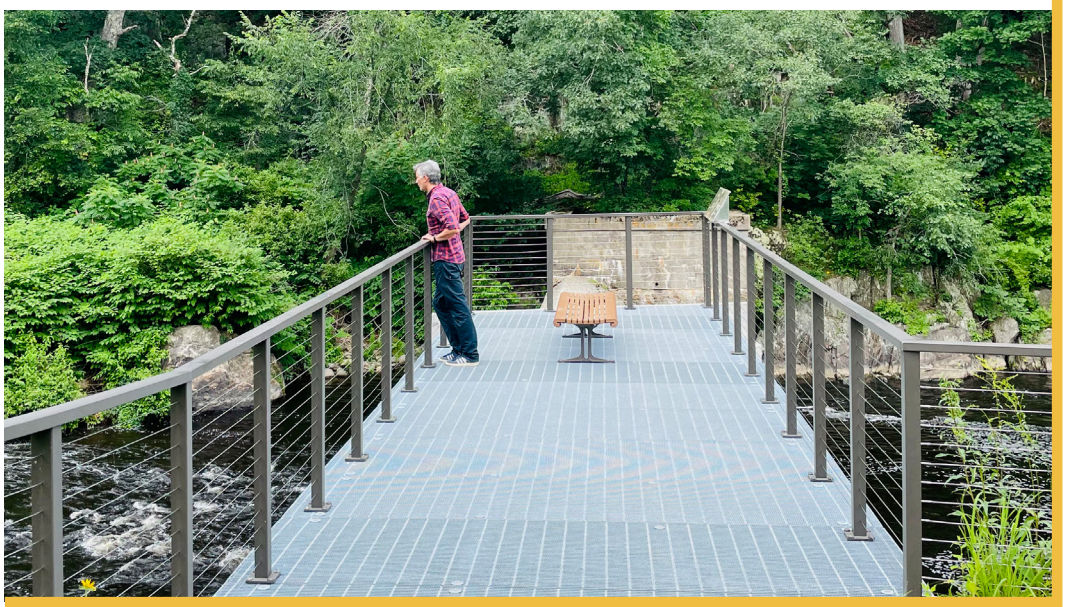
City of Kent: https://www.kentohio.org/409/Dam-Restoration-Project

CASE STUDIES - REMOVAL

HEAD TIDE DAM

PROJECT SUMMARY

Although outside of the Narragansett Bay watershed, the High Tide Dam in Alna provides a case study of a partial removal of a dam. The project consisted of the removal of 26 feet of the west side of the dam, the construction of an overlook in its place, construction of a retaining wall at the foundation of an old mill, and the addition of a path to the river. The modification of the Alna dam is the second project in a series of three projects aiming to improve fish passage in the Sheepscot River, improve public safety and access, and honor the history at the individual sites. The first of the three projects, completed in 2018, was the removal of the Coopers Mills Dam in Whitefield upstream of the Head Tide Dam. The third project, at Branch Pond Mill Dam in the town of China, Maine, will stabilize the dam and install a fishway. Together the project aims to improve fish passage on the Sheepscot River which is home to the southernmost genetically unique wild populations of Atlantic salmon remaining as well as 11 other species of migratory species.



LOCATION
Alna, Maine

RIVER
Sheepscot River

YEAR
2019

GOAL
Improve fish passage, enhance public safety and access, and honor the history of individual sites.

TYPE
Partial Removal

COST
$515,000.

PROJECT PARTNERS
Town of Alna, Atlantic Salmon Federation (ASF), The Nature Conservancy, Midcoast Conservancy, National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service, Maine Department of Marine Resources, Maine Department of Environmental Protection, and the National Fish and Wildlife Foundation.

FUNDING SOURCES
NOAA Community Habitat Restoration Program, US Fish and Wildlife Service, Enbridge Corporation, The Nature Conservancy, Elmina B. Sewall Foundation, Davis Conservation Foundation, Patagonia, Farnsworth Foundation, Trout and Salmon Foundation and others.

CHALLENGES:

The Head Tide Dam was constructed over 250 years ago to power a series of mills in Alna. The Jewett family donated the dam to the town in 1964. One of the main challenges in the project was deciding whether work could proceed due to a covenant in the deed stating the dam could never be destroyed.

SOLUTIONS:

To address the concerns about the legal deed covenant, the decision was made to partially remove the western portion of the dam. The partial dam removal and construction of the overlook platform – which maintained "one contiguous line from shore to shore" – was deemed acceptable by Alna selectmen and legal counsel as complying with the legal deed covenant. In addition, the partial removal maintained a portion of the historic structure as a landmark for the community.

Public access was an important aspect of the redesign of the site. Over the western portion of the river where the dam was removed, an elevated ADA accessible viewing platform was constructed. The viewing platform provided a space for informational signage and a lookout onto the river. By using a grate rather than concrete for the elevated walkway, the project team hoped that it wouldn't deter shad which can be sensitive to passing under concrete. The final design maintained and strengthened recreational opportunities at the site. By maintaining part of the dam, a swimming hole that has been a popular destination for generations was preserved. In addition, the pedestrian path down to the river provided access to the river and a safe place to put in and take out kayaks and canoes.

SUCCESSES:

The partial removal of the Head Tide Dam is a good example of the ability to think and work creatively to address legal limitations on a project. It also was successful in providing habitat connectivity as well as preserving the historic dam structure that was important to the community.

LESSONS LEARNED:

The partial removal of the Head Tide Dam dam resulted from a strong team that worked on the project. The restoration team did not go into the community with a preconceived idea of what needed to happen but rather worked with the community to decide how to improve fish passage and river connectivity.

Just because there are legal challenges or deed restrictions on a dam, doesn't mean that modifications can not be made to a dam. This project highlights the opportunity to think creatively to work through legal challenges and deed restrictions.

View of the steps down to the river and the overlook over the removed portion of the dam.

REFERENCES and ADDITIONAL RESOURCES

https://atlanticsalmonrestoration.org/projects/magic-on-the-river

https://lcnme.com/currentnews/work-starts-at-head-tide-dam-in-alna/

https://lcnme.com/currentnews/head-tide-dam-project-a-gift-thats-going-to-outlive-us-all/

FISH LADDERS

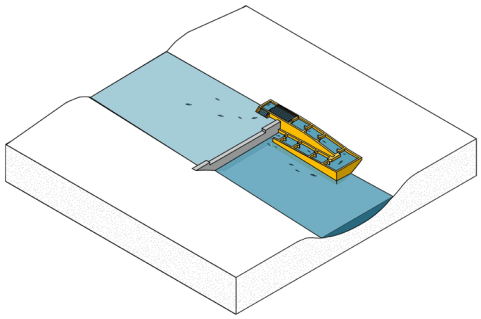
A conventional fishway, commonly nicknamed "fish ladder," is a structure that is built alongside an existing dam that is intended to provide a corridor for aquatic species to swim up and over the dam barrier, then back down. Conventional fishways may be an option where there is a desire to provide some fish passage without removing the dam. Selecting the most appropriate fishway for a given project will depend upon the slope, budget, flow conditions, and target species.

Those unfamiliar with fish ladders may be surprised at the complexities and challenges that must be overcome for these to function well with a variety of species (e.g., river herring, shad, eels) and life stages (juvenile vs. adult). Fish vary dramatically in their swimming speed, stamina and leaping ability. The slope, turbulence, placement of resting areas and other design features are essential elements. Unfortunately, a "one-size-fits- all" approach with fishways rarely works. In addition, fish seek particular velocities and pathways through a river channel as they move upstream. If the entrance placement and water flow out of a fish ladder does not match preferred conditions, migrating fish will not use the ladder and can mass in huge numbers at the base of a dam – negating the entire fish ladder. The design of fish ladders that will accommodate multiple fish species and life stages is not yet a mature science and many fish ladders require costly alterations after construction.

If a dam has received a letter of deficiency, the dam would need to be repaired prior to constructing the fishway. In addition to this upfront cost, this scenario requires long-term maintenance of the dam and the fishway. Conventional fishways vary in cost, aesthetics, and performance depending on the design and dam structure. They are not inexpensive and frequently cost upwards of half a million dollars.

There are 3 general types of conventional fishways found within Narragansett Bay Watershed: Denil fishway, Alaskan steeppass fishway and Weir and Pool fishways.

TECHNICAL FISH LADDERS



FISH PASSAGE UP AND DOWN STREAM

Low Fish Passage — 1 2 3 4 5 — *High Fish Passage*

UPSTREAM WATER LEVELS

Potential Lowering of Water Levels — 1 2 3 4 5 — *Maintain Existing Upstream Water Levels*

RECREATION ON THE IMPOUNDMENT

Reduced Flat Water Recreational Opportunities — 1 2 3 4 5 — *Maintains Existing Flat Water Recreational Opportunities*

RECREATION ON THE RIVER

Maintains Existing Difficulties to River Recreation — 1 2 3 4 5 — *Improves River Recreation by removing hazards and portages*

VISIBILITY OF DAM

Dam Structure No Longer Visible — 1 2 3 4 5 — *Dam Structure Remains Visible*

WATER QUALITY

Maintain Existing Water Quality — 1 2 3 4 5 — *Improve Water Quality*

RISK OF DAM FAILURE

No Risk of Failure — 1 2 3 4 5 — *Maintain Existing Risk of Failure*

UP-FRONT COST

Less Expensive — 1 2 3 4 5 — *More Expensive*

LONG-TERM COST AND MAINTENANCE

Lower Long Term Cost And Maintenance — 1 2 3 4 5 — *Higher Long Term Cost And Maintenance*

CASE STUDIES - FISH LADDER

HORSESHOE FALLS DAM

PROJECT SUMMARY

Located in Shannock Village on the Upper Pawcatuck River, the Horseshoe Falls Dam was built around 1759. The last working mill burned down in 1856, but the dam remained and repairs were made over the years. Rich in both cultural and historical value and located in a well-populated area, the dam was not a good candidate for complete or even partial removal, as the site is well known and appreciated for its aesthetic value. In 2010, the community and the local stakeholders decided to build a Denil fishway and eel passage structure. The Horseshoe Falls fish ladder installation was part of a comprehensive project that opened fish passage through seven dams along the Pawcatuck River.

LOCATION
Charlestown/Richmond, RI

RIVER
Pawcatuck River

YEAR
2010

GOAL
Migratory fish passage + historic preservation

TYPE
Denil Fishway

COST
$628,469

PROJECT PARTNERS
Wood Pawcatuck Watershed Association; Kenyon Industries, Inc; Town of Charleston; Trout Unlimited; United States Fish and Wildlife Service; RI Coastal Resources Management Council; RI Department of Environmental Management; National Oceanic and Atmospheric Administration; Save the Bay; Richmond Conservation Commission; Town of Charlestown; USDA Natural Resources Conservation Service; American Rivers; Fuss and O'Neill; and Narragansett Bay Estuary Program.

CHALLENGES:

Removal of the dam was challenged as the Horseshoe Falls Dam was a local landmark widely appreciated for its scenic beauty. It is the only horseshoe-shaped falls in Rhode Island. Many perceive Horseshoe Falls Dam as an historically significant part of the state's industrial heritage.

SOLUTIONS:

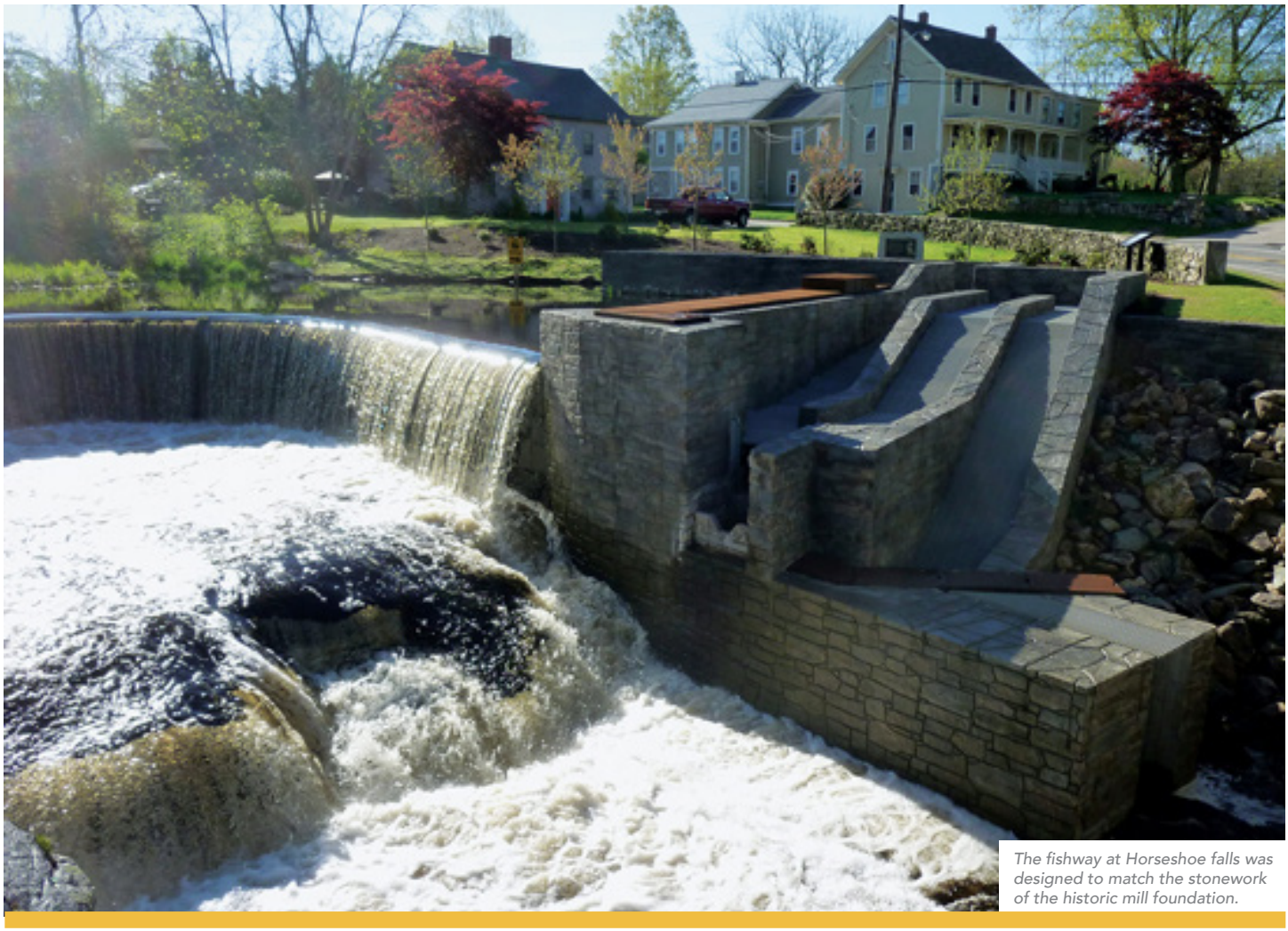
Due to the dam's scenic beauty and historical importance, the restoration project required sustained outreach to ensure all stakeholders were heard and all interests were met. An elaborate state of the art Denil fishway was designed to allow alewife and eel passage. To ensure the fishway did not look out of place, engineers shaped the exterior of the fishway to match the stones of the original mill foundation on the opposite bank.

SUCCESSES:

This project was able to meet the dual objectives of improving fish passage and the preservation of the historic arch dam structure.

LESSONS LEARNED:

The Horseshoe Falls Dam fishway project demonstrates that there is room for flexibility in discussions between dam removal and historic preservation. Creative alternatives can achieve project goals like fish passage without compromising the aesthetic of a cherished landmark.



The fishway at Horseshoe falls was designed to match the stonework of the historic mill foundation.

REFERENCES and ADDITIONAL RESOURCES

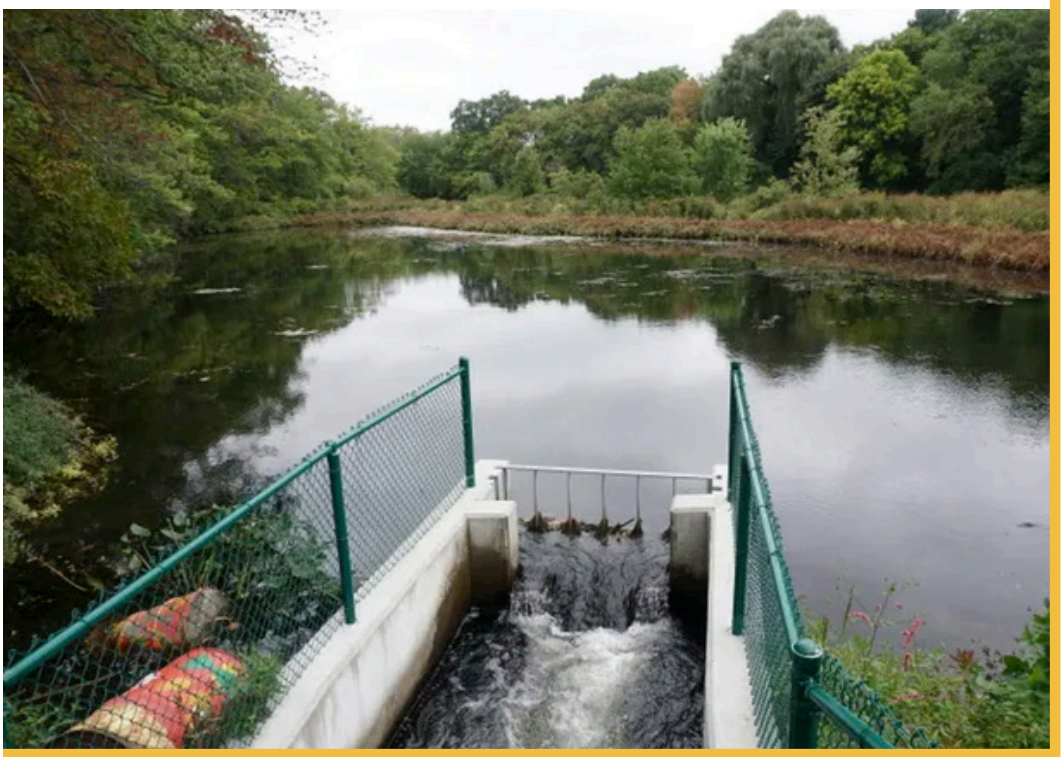
Wood Pawcatuck Watershed Association's presentation: http://www.wpwa.org/documents/WPWA%20Horseshoe%20Presentation.pdf

CASE STUDIES - FISH LADDER

MANTON MILL POND DAM

PROJECT SUMMARY

The Woonasquatucket River has been designated an "American Heritage River" by the U.S. Environmental Protection Agency (EPA) for its legacy of use for food and energy before and during the Industrial Revolution. Since the 1990's, the Woonasquatucket River Watershed Council has been working to restore the health of the river and provide access and recreation opportunities for the surrounding community. This work has included the restoration of dams within the river as well as upgrades to a Greenway network that runs adjacent to the river. The fishway installed at Manton Mill Pond Dam is the fifth in a series of dam removal and fish passage projects along the lowest stretch of the Woonasquatucket River.



LOCATION
Providence, Rhode Island

RIVER
Woonasquatucket River

YEAR
2016

GOAL
Migratory fish passage, Public art, Education

TYPE
Denil Fishway

COST
$492,000

PROJECT PARTNERS
Woonasquatucket River Watershed Council (WRWC), Rhode Island Department of Environmental Management (DEM), Rhode Island Coastal Resources Management Council (CRMC), EA Engineering, U.S. Department of Agriculture (USDA), Preferred Equipment Resource.

CHALLENGES:

The dam is a concrete run-of-river dam. Located downstream of the Centredale Manor Superfund site in North Providence, the Manton Mill dam accumulated toxic sediment (dioxins) from chemical production that took place from the 1940s-1970s. Because these pollutants are persistent, dam removal could pose danger to communities and habitats downstream. Therefore, the decision was made to add a fish ladder rather than remove the dam.

SOLUTIONS:

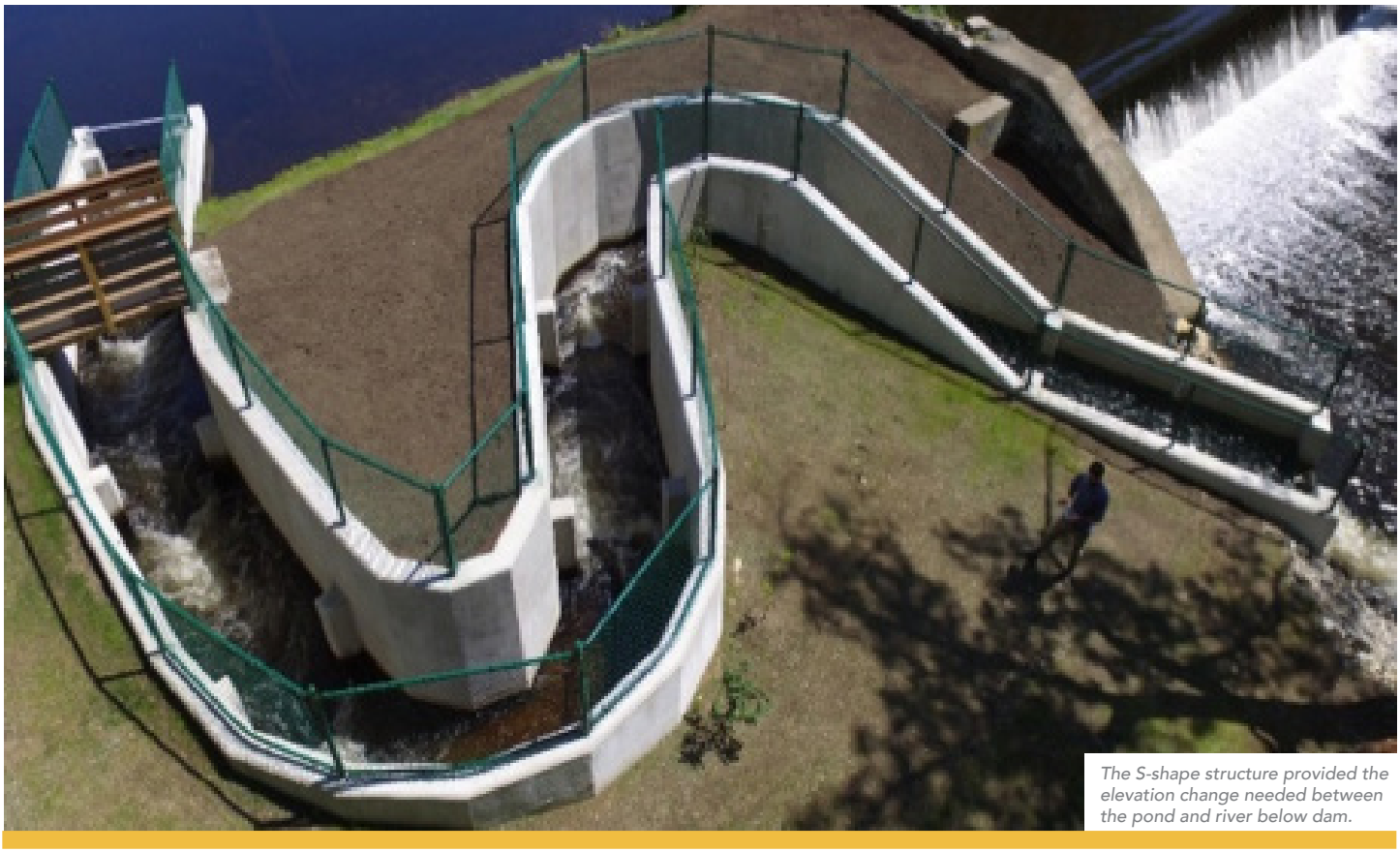
Before construction of the fishway could begin, areas of toxic, dioxin-impacted sediment were removed from the site. The fishway was designed with S-shaped concrete walls with a series of pools and weirs that allow for upstream migration.

SUCCESSES:

Completed in 2016, the new fishway was designed to allow up to 40,000 herring to migrate upstream each year. The S-shaped fishway allows other project goals to be met as well; public art pieces were incorporated into its concrete surface and it is an ideal location to observe the spring fish migration. Local schools have begun to use the new fishway as an educational tool--bringing students to the Woonasquatucket to teach them about habitat restoration.

LESSONS LEARNED:

Because dams within New England were typically constructed to support industrial activities, toxic sediment accumulation behind a dam is a common concern. In order to mitigate the potential impact of dam removal releasing toxic sediments downstream, it is often necessary to keep the dam when contaminated sediments are present.



The S-shape structure provided the elevation change needed between the pond and river below dam.

REFERENCES and ADDITIONAL RESOURCES

Woonasquatucket River Watershed Council: https://wrwc.org/wp/what-we-do/restoration/fish-passages/

CASE STUDIES - FISH LADDER

GILBERT STEWART DAM

PROJECT SUMMARY

Gilbert Stuart Stream is the largest freshwater tributary to the Narrow River, which empties into the Narragansett Bay. For over a century, a small dam located at the historic home of artist Gilbert Stuart has impeded the passage of migratory river herring, who travel up the Narrow River via Gilbert Stuart Stream and into Carrs Pond to spawn. In the 1960's, Rhode Island's Division of Fish and Wildlife installed an Alaskan steeppass fish ladder that allowed thousands of migrating river herring to pass to Carrs Pond.

LOCATION
North Kingstown, RI

RIVER
Gilbert Stuart Stream / Narrow River

YEAR
1960's (fish ladder),
2021 (picket weir)

GOAL
Migratory fish passage

TYPE
Alaskan steeppass fishway

PROJECT PARTNERS
Gilbert Stuart Birthplace & Museum, Rhode Island Division of Fish and Wildlife (1960's fish ladder) The Nature Conservancy, the RI Department of Environmental Management (DEM), Horace and Ella Kimball Foundation, Narragansett Improvement and Preservation Foundation, Rhode Island Saltwater Anglers (picket weir).

CHALLENGES:

Although the 1960's fish ladder allowed herring to pass to Carrs Pond above the dam, a junction that led to a mill race frequently attracted and confused the fish, forcing them to choose the wrong path. If the herring turned into the mill run instead of the fishway, they were prone to becoming trapped and ultimately dying.

SOLUTIONS:

The Gilbert Stuart Museum was able to maintain the character of the historic dam by implementing a barrier that would allow water, but not fish, to pass through the mill run. The blocking structure, known as a picket weir, resembles a picket fence and is aesthetically consistent with the historic character of the surrounding property. This picket weir is a novel alternative to the Department of Environmental Management's practice of using temporary plastic fencing, which can be visually distracting and prone to failure during high flow.

SUCCESSES:

In recent years, between 30,000 and 100,000 herring may be seen migrating up the Gilbert Stuart fish ladder. The Gilbert Stuart Birthplace & Museum hosts an annual spring fair, where visitors are encouraged to watch the herring run from trails and bridges, as well as via an underwater camera stream. The Shady Lea Mill dam, situated above Carrs Pond on the Mattatuxet River, was designated as a "high hazard" and was removed in 2018. This subsequent project opened an additional ½ mile of river to the herring, eels, and trout.

The Alaska steeppass is a prefabricated, modular style of Denil fish ladder.

REFERENCES and ADDITIONAL RESOURCES

Narrow River Preservation Association: https://narrowriver.org/river-herring/

OLIVER MILLS (MUTTOCK) DAM

PROJECT SUMMARY

The Nemasket River supports the largest and longest herring run in Massachusetts. The herring make the yearly 40-mile journey from Mount Hope Bay through the Taunton and Nemasket River to the Assawompset Pond Complex to spawn. Members of the Wampanoag Tribe built weirs to catch migrating herring each spring in a village at Muttock (now Oliver Mills area). In 1734, the weirs were replaced by a dam, which was used to power iron works, grist, and saw mills serving the colony of Middleborough until it was abandoned in the 1870s. Throughout this period, the site remained an active fish run, with highly organized yearly efforts to catch and distribute the passing herring, which were cooked and distributed at the nearby community herring house. The Oliver Mills dam is the first of three dams on the Nemasket River between the undammed Wild and Scenic Taunton river and the valuable spawning grounds of the Assawompset Pond Complex.

LOCATION
Middleborough, MA

RIVER
Nemasket River

YEAR
1982

GOAL
Migratory fish passage

TYPE
Pool and Weir Fishway

COST
Unknown

PROJECT PARTNERS
Massachusetts Division of Marine Fisheries.

CHALLENGES:

The mill and dam remained in a state of abandonment until the 1960's, when Oliver Mill Park was opened surrounding the dam and historic industrial ruins. Herring populations in the Nemasket River declined dramatically during this time, with a mysterious die-off event in 1965. Low water levels and invasive plants exacerbated the issue and prompted proposals to reestablish fish passage on the river.

SOLUTIONS:

The fishways at Oliver Mill were initiated by an effort to restore the ecological and cultural heritage of the Nemasket River. During the 1960's and 1970's the site was partially restored for recreation, fish passage, and to preserve the industrial archeological site. During this time, two stone fish ways were installed. In 1982, the Massachusetts Division of Marine Fisheries built a new stone and concrete notched weir-pool fishway. In 1996 the Middleborough-Lakeville Herring Fishery Commission was created to administer and enforce herring harvest regulations, maintain and enhance herring habitat, and public education on the herring run.

SUCCESSES + LESSONS LEARNED:

The Nemasket River is relatively short (11.2 miles) with only 3 dams between the ocean and the 1,721 acres of prime spawning grounds of the Assawompset Ponds. Taking a whole river approach, fishways have been constructed at all three dams, allowing fish passage into the ponds. In 2013, almost one million herring were able to pass through the fishway at Oliver Mill to spawn in Assawompset Pond!

The communities of Middleborough and Lakeville have been shaped by the abundance of herring in the Nemasket River. In addition to the ecological value of the annual hearing run, it is also an important social and cultural event. Community support to preserve the yearly fish run helped to spur the restoration of the river and the fish migration. Since 2013, local and state Cultural Councils and the Middleborough Tourism Committee have hosted the Annual Herring Run festival to bring the community together to celebrate the fishrun. These celebrations help to reinforce the relationship between the community and the herring, ensuring the herring remain an important part of the local identity and helping to spur continued stewardship and involvement in preserving and improving the annual fish runs.

This case study is also an example of how a fishway can be integrated into a public park to achieve multiple objectives. With the creation of the Oliver Mill Park, the project was able to achieve the shared goals of improving fish passage, providing recreation, and preserving history. The fishways are integrated into the design of the park allowing the fishruns to be highly visible. Oliver Mill park provides paths for visitors to see the historic stone mill ruins and bridges that cross the multiple river channels and allow visitors to see the herring run below. In 2000, Oliver Mill Park was listed on the National Register of Historic Places as the Muttock Historic and Archeological District.

The fishway at Oliver Mills is integrated into the design of a public park.

REFERENCES and ADDITIONAL RESOURCES

DAMARISCOTTA MILLS

PROJECT SUMMARY

Although outside of the Narragansett Bay watershed, the Damariscotta Mills provides a unique case study of a fish ladder. In Algonquian, the name Damariscotta means "place of an abundance of alewives."However, in 1729, a double sawmill was constructed at the falls between fresh water Damariscotta lake and the tidal headwaters of the Damariscotta river. The dams blocked the annual alewife migration. In 1741, the legislature called for fish passage at Damariscotta mills, but it wasn't until 1807 that the towns built the new "stream" to bypass the dam. In 2007, after two centuries of use, a restoration project was initiated by a strong community group working with the Towns of Nobleboro and Newcastle and the Nobleboro Historical Society to restore the deteriorating fish ladders.

LOCATION
Nobleboro, Maine

RIVER
Damariscotta River

YEAR
Originally constructed in 1807 and then restored and rebuilt and restored between 2007-2017

GOAL
Fish passage

TYPE
Pool and Weir Fishway

COST
Restoration cost over $1,000,000

PROJECT PARTNERS
Towns of Nobleboro and Newcastle, the Nobleboro Historical Society, US Fish and Wildlife Service, Maine Department of Marine Resources, and the involvement of many community members.

CHALLENGES:

The original fish ladder was a series of small pools connected by short passages that raised over 42 feet from the bay to the impoundment. The fish ladder worked well for about 180 years but its stonework and the underlying concrete deteriorated as ice dislodged stones and blocked the path for the fish. By the 1990s, the fish ladder was in very poor condition, and fish count plummeted to less than 200,000.

SOLUTIONS:

With strong community organizing, and fundraising, the reconstruction of the fish ladder began in 2007. The redesign and reconstruction of the fish ladder is similar to that of the original, consisting of a series of 69 ascending pools connected by weirs, or short waterfall passageways that each rise 8-10 inches. The reconstruction took over 10 years and could only take place from November - April to avoid spawning season. In April every year, the construction team had to stop so the ladder could be used for the spring migration. The renovated ladder winds 1,500 feet up the hill and was reconstructed using the original stones and designed to weave around mature trees that shade the pools.

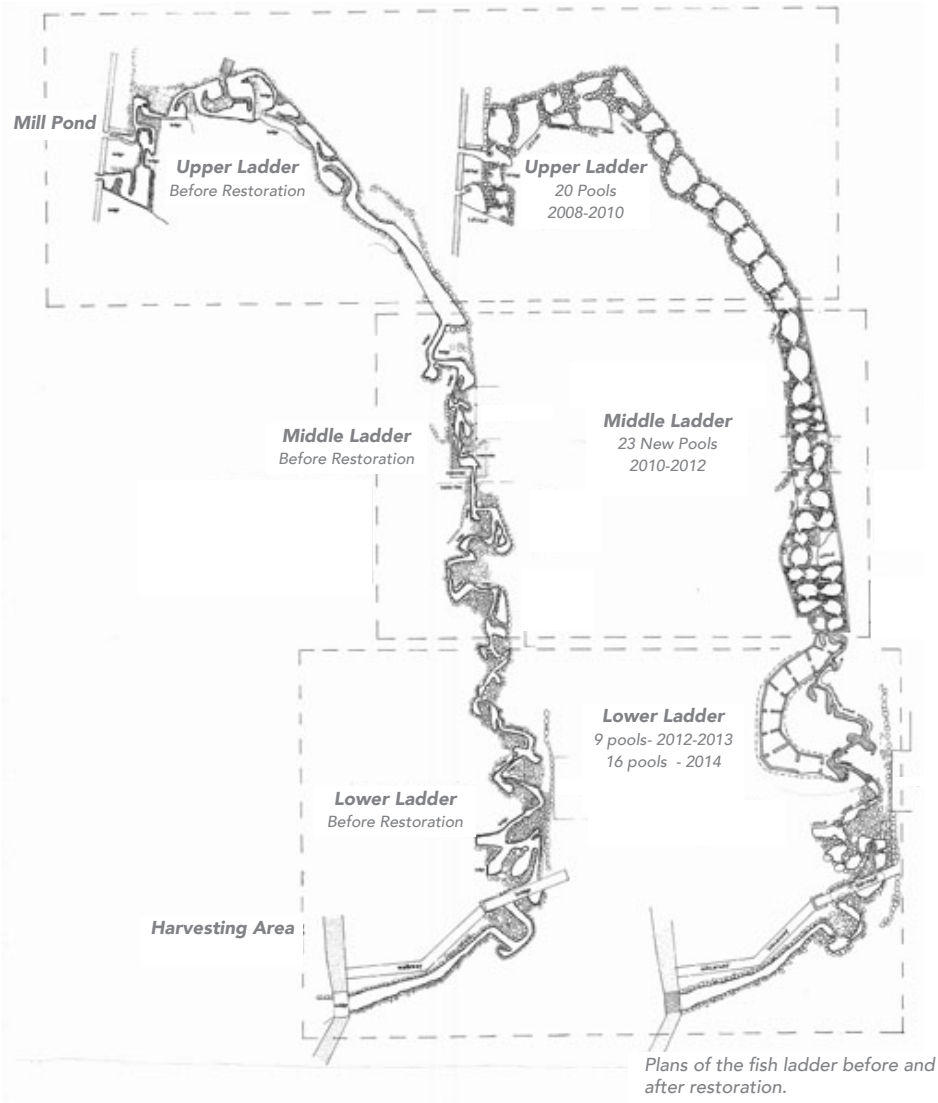
The lower pools are publicly accessible and include a boardwalk and signage. The upper portions snake through residential backyards before reaching the lake.

At the lower end of the pools, a set of "dippers" and troughs, allow for the towns to harvest alewife. The harvested alewives are used primarily as lobster bait however a few bushels are smoked and sold for human consumption. All funds received for harvested alewives are spent to maintain and restore the fish ladder and harvesting area.

SUCCESSES:

Following the restoration, more than one million alewives pass up the fish ladder to spawn each spring making the Damariscotta river one of Maine's oldest and most productive alewife fisheries.

Community support has been key to the restoration of the fish ladders. An annual Herring festival took place from 2007 until the pandemic and helped raise funds and support for the restoration. Currently the community group is raising funds to replace the boardwalk and foot bridges . Volunteers are present at the Fish Ladder on May weekends to welcome visitors, and sell tee shirts caps and other Fish Ladder. In addition, fundraising takes place at community events such as a silent auctions, an annual "Alewife run" and concerts.



Plans of the fish ladder before and after restoration.

REFERENCES and ADDITIONAL RESOURCES

https://damariscottamills.org/

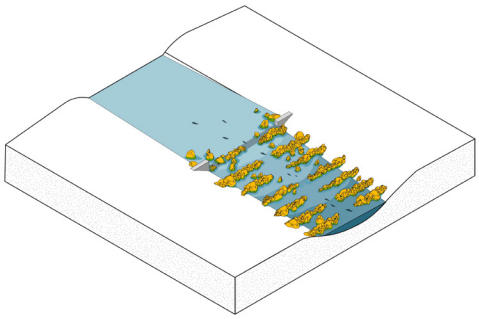
https://www.atlasobscura.com/articles/fish-ladder-maine-lobster-industry

NATURE-LIKE FISHWAYS RIVER WIDE

A nature-like fishway resembles a natural river with a series of pools and riffles. It consists of a wide, low-gradient channel that is constructed with rocks and boulders that are gradually terraced to make up the height difference between the below-dam and above-dam elevation. Boulders in the channel create multiple pathways that vary in length and velocity to allow multiple fish species to swim upstream. Because nature-like fishways are wide and gradual channels, they also provide improved fish habitat connectivity up and downstream. Nature-like fishways may be suitable for low height obstructions, where upstream water level control is not essential, and if there is a need or desire to preserve the upstream impoundment due to recreation, well water, contaminants or habitat. Nature-like fishways vary in cost, aesthetics, and performance depending on the design and dam structure

River-Wide Nature Like Fishways - In this scenario, the river downstream of the dam is gradually raised to the elevation of the dam across the whole river channel through a series of rock/pools. Because the fishway spans the whole width of the river channel, the dam is no longer visible. In this scenario, there needs to be sufficient space downstream to build up the channel gradually to the height of the dam. Frequently, the dam is partially lowered to reduce the elevation the downstream channel has to be raised. In addition to full width nature-like fishways, there is an option for partial width fishways that only extend across a portion of the river width.

NATURE-LIKE FISHWAY



FISH PASSAGE UP AND DOWN STREAM

Low Fish Passage — 1 2 3 4 5 — *High Fish Passage*

UPSTREAM WATER LEVELS

Potential Lowering of Water Levels — 1 2 3 4 5 — *Maintain Existing Upstream Water Levels*

RECREATION ON THE IMPOUNDMENT

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VISIBILITY OF DAM

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WATER QUALITY

Maintain Existing Water Quality — 1 2 3 4 5 — *Improve Water Quality*

RISK OF DAM FAILURE

No Risk of Failure — 1 2 3 4 5 — *Maintain Existing Risk of Failure*

UP-FRONT COST

Less Expensive — 1 2 3 4 5 — *More Expensive*

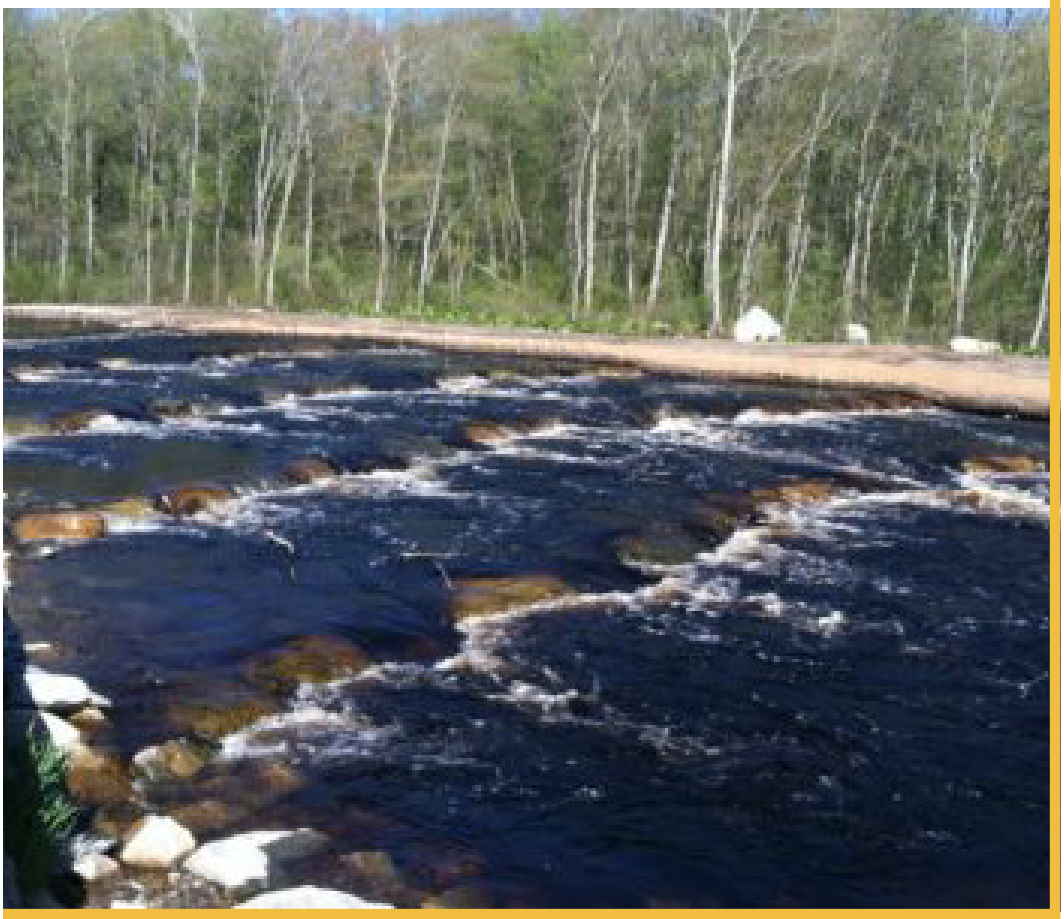
LONG-TERM COST AND MAINTENANCE

Lower Long Term Cost And Maintenance — 1 2 3 4 5 — *Higher Long Term Cost And Maintenance*

KENYON MILL DAM

PROJECT SUMMARY

Located on the Upper Pawcatuck River in Rhode Island, Kenyon Mill was built around 1772. The privately-owned mill houses and Kenyon Industries, a fabric producer housed in the historic mill building, once used the impoundment created by the dam to retain water for possible fire suppression. By 2010, the dam had fallen into disrepair and had a partial breach at the end of its spillway. This work was part of a comprehensive project that opened fish passage through seven dams along the Pawcatuck River.



LOCATION
Richmond, Rhode Island

RIVER
Pawcatuck River

YEAR
2013

GOAL
Migratory fish passage

TYPE
River Wide Nature Like Fishway

COST
$1,124,322

PROJECT PARTNERS
Wood Pawcatuck Watershed Association; Kenyon Industries, Inc.; Town of Richmond; Trout Unlimited; United States Fish and Wildlife Service; RI Coastal Resources Management Council; RI Department of Environmental Management; National Oceanic and Atmospheric Administration; Save the Bay; Richmond Conservation Commission; USDA Natural Resources Conservation Service; American Rivers; and Narragansett Bay Estuary Program.

CHALLENGES:

The neighboring community did not support full dam removal due to concerns about the impacts of lowered water levels on residential wells upstream. In addition, Kenyon Mills owned the dam and was willing to have it removed, but needed the impoundment for fire suppression.

SOLUTIONS:

Construction crews implemented a partial dam removal and installed a rock ramp, or nature-like fishway spanning the full width of the river channel. The dam height was lowered and a rock ramp was constructed to create the riffles and flow necessary to sustain fish passage with a gradual incline in elevation.

SUCCESSES:

Creating a nature-like fishway provided fish passage while allowing for the impoundment to remain upstream, providing water for fire suppression and ensuring that the upstream wells would not lose drinking water. In addition, during low flow, the rock ramps provide diverse habitat along the river's edge.

The Kenyon Mills Nature Like Fishway created pockets of wetland habitat between the weirs.

REFERENCES and ADDITIONAL RESOURCES

Wood Pawcatuck Watershed Association's presentation: http://www.wpwa.org/documents/KenyonPublicPresentation%20(3).pdf

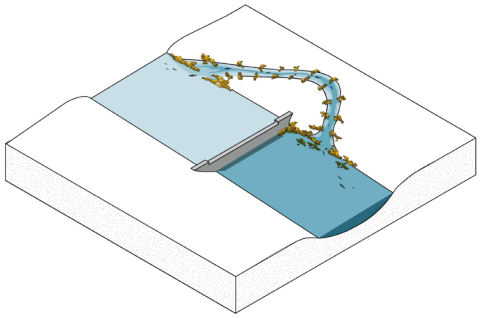
Turek, J., A. Haro, and B. Towler (2016). Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes. Interagency Technical Memorandum.

NATURE-LIKE FISHWAYS BYPASS CHANNEL

A nature-like fishway resembles a natural river with a series of pools and riffles. It consists of a wide, low-gradient channel that is constructed with rocks and boulders that are gradually terraced to make up the height difference between the below-dam and above-dam elevation. Boulders in the channel create multiple pathways that vary in length and velocity to allow multiple fish species to swim upstream. Because nature-like fishways are wide and gradual channels, they also provide improved fish habitat connectivity up and downstream. Nature-like fishways may be suitable for low height obstructions, where upstream water level control is not essential, and if there is a need or desire to preserve the upstream impoundment due to recreation, well water, contaminants or habitat. Nature-like fishways vary in cost, aesthetics, and performance depending on the design and dam structure

Bypass Nature-Like Fishways - In this scenario, a new channel is constructed to bypass the dam and connect the river upstream of the dam to the river downstream of the dam. This alternative requires that there is land adjacent to the dam where a channel can be excavated and graded using the rock/pool strategy. It is a good alternative to consider if the dam is a historic structure or there is the desire to protect views of the dam structure itself. If a dam has received a letter of deficiency, the dam would need to be repaired prior to constructing a by-pass channel. In addition to this upfront cost, this alternative requires long-term maintenance.

BYPASS CHANNEL



FISH PASSAGE UP AND DOWN STREAM

Low Fish Passage — 1 2 3 4 5 — *High Fish Passage*

UPSTREAM WATER LEVELS

Potential Lowering of Water Levels — 1 2 3 4 5 — *Maintain Existing Upstream Water Levels*

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HOWLAND DAM BYPASS CHANNEL

PROJECT SUMMARY

Although outside of the Narragansett Bay watershed, the Howland Dam case study is a good example of a nature-like bypass channel. The Penobscot River Restoration Project was a decades-long effort to restore migratory fish passage while maintaining hydropower within Maine's largest watershed. In order to reconnect the Lower Piscataquis River to the Upper Penobscot River, various dams needed to be altered or removed to accommodate passage. In 2012, the Great Works dam was removed at the head of tide, followed by the 2013 removal of the Veazie Dam, and 2014 installation of a fish lift at Milford Dam. The Howland Dam would become the final obstacle in the effort to reconnect the two rivers.

LOCATION
Howland, Maine

RIVER
Piscataquis River

YEAR
2016

GOAL
Migratory fish passage, Maintain hydropower

TYPE
Bypass- Nature Like Fishway

COST
~$4.8 million

PROJECT PARTNERS
Penobscot River Restoration Trust, Penobscot Indian Nation, Atlantic Salmon Federation, The Nature Conservancy, American Rivers, Natural Resources Council of Maine, Maine Audubon, Maine Department of Marine Resources, Maine Department of Inland Fisheries and Wildlife, Maine Department of Environmental Protection, U.S. Fish and Wildlife SErvice, National Marine Fisheries Service, Kleinschmidt, Inter-Fluve.

FUNDING SOURCES
50/50 by government grants and private donations.

CHALLENGES:

Because the Howland, Great Works, and Veazie Dams once generated hydroelectric power, production would need to be shifted elsewhere. The river also experienced dramatic variations in flow, necessitating careful monitoring of volume and velocity to prevent flooding.

SOLUTIONS:

The project team ensured that hydroelectric energy production could continue by strategically decommissioning the existing facilities and implementing system upgrades at six other sites. These upgrades resulted in as much hydropower production as before the dam removals. A nature-like bypass channel was designed to resemble a natural stream, reflecting ideal conditions for migratory species. In order to re-grade the sloped site into a channel, bedrock was blasted and strategically placed throughout the stream bed to create roughness and water perturbation critical to the health of migrating fish.

SUCCESSES:

This project was the first large-scale natural fish passage channel of its kind, allowing for a restored Salmon run up the Penobscot River. Its complex construction accommodates a wide range of flow volumes and velocities. Overall, the Penobscot River Restoration Project restored nearly 2,000 miles of historic river habitat.

The Nature-Like bypass channel allowed fish passage and continued recreation on the impoundment.

REFERENCES and ADDITIONAL RESOURCES

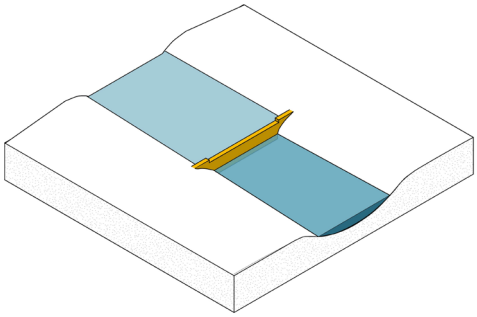
PENOBSCOT RIVER RESTORATION TRUST: https://www.nrcm.org/wp-content/uploads/2016/06/Howlandbypassfacts.pdf

REPAIRING THE DAM

For social, economic, and/or environmental reasons, keeping and repairing a dam is sometimes the option selected for a dam and its community. Some reasons a dam may be preserved include: the presence of contaminated sediment behind a dam; the dam is listed on the national registry of historic places; rare or endangered species are found in the upstream impoundment; and there are multiple dams downstream that block fish passage. Depending on the location of the dam within the watershed and the importance of fish passage, repairs to the dam can be combined with other fish passage structures. For example, if a dam is located in the headwaters (upstream) where anadromous fish passage is not a priority and where the cost of providing fish passage is very expensive, the decision may be made to just repair the dam. However, if the dam is located close to where the river meets the ocean and providing fish passage is a priority but removal is not possible, the dam may be repaired and a fish passage structure may be added. If the decision is made to keep a dam, structural deficiencies must be addressed through repairs and future inspection and maintenance needs to be factored into cost estimates.

With dam repair, the structure of the dam would remain and the existing surrounding ecology would be unaffected. However, unless fish passage structures are added, there would be no fish passage or habitat connectivity above this dam. And while this may be one of the least expensive alternatives in the short term, this alternative requires long-term maintenance so cost over time needs to be considered.

REPAIRING THE DAM



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